Information of hormonal receptors, including estrogen receptor (ER) and progesterone receptor (PR), is essential in management of breast cancer patients. In a recent study by Chen et al. [1], it was found that ER-positive and -negative breast cancers demonstrated different imaging features on magnetic resonance imaging (MRI). However, since the status of PR was consistent with that of ER in most patients (ER+/PR+ or ER−/PR−) in that study, the impact of PR was not analyzed. Previous studies have shown that lack of PR expression was associated with aggressive tumors [2, 3]. In this work, the association between PR status and MRI features was investigated.

In a retrospective review of our breast MRI database from 2001 to 2007, 25 patients with ER+/PR− invasive breast cancer were found, including 21 invasive ductal cancers and four invasive lobular cancers. A group of 29 consecutive patients with ER+/PR+ invasive ductal cancer was taken from the previously published study [1] for comparison. The age range was 34–70 years old (mean 53) for the ER+/PR+ patients and 34–81 years old (mean 59) for the ER+/PR− patients (P = 0.05). The MRI features between these two groups were compared. This study was approved by the institutional review board and was Health Insurance Portability and Accountability Act (HIPAA) compliant. All patients gave informed consent.

The MRI study was carried out using a 1.5 T MR scanner with a standard bilateral breast coil. The imaging protocol consisted of high-resolution precontrast imaging and bilateral axial dynamic contrast-enhanced imaging. For the dynamic imaging acquisition, a 3D SPGR (RF-FAST) pulse sequence was prescribed. The sequence was repeated 16 times, four precontrast and 12 postcontrast sets. The subtraction images at 1 min after contrast injection from 32 slices were generated, then used to form the maximum intensity projection (MIP). Tumor size was measured as the longest tumor dimension on the MIP. The enhancement kinetics was analyzed from manually drawn region of interest on each subtraction imaging slice at 1 min after injection containing the lesion. The enhancement time course was calculated by subtracting the mean precontrast signal intensity from each of the subsequent 12 postcontrast signal intensities. The tumor morphology and kinetic enhancement features were analyzed based on ACR Breast Imaging Reporting and Data System (BI-RADS) MRI lexicon [4]. The axillary lymph node status was evaluated on precontrast sagittal view images.

Most of the patients in both groups, including all ER+/PR+ cancers (29/29) and 21 of 25 ER+/PR− cancers, presented as mass-type lesion (P < 0.05). Four ER+/PR− breast cancers presented as nonmass-type lesions, including three regional enhancements and one linear enhancement. The mean tumor size was significantly bigger in the ER+/PR− cancers than the ER+/PR+ cancers (2.4 ± 1.3 versus 1.7 ± 1.0 cm, P < 0.05). For lesions multiplicity, five ER+/PR− patients (5/25, 20%) and eight ER+/PR+ patients (8/29, 27.5%) showed multiple lesions (P = 0.54). Axillary lymph nodes were detected by MRI in nine ER+/PR− patients (9/25, 36%) and in six ER+/PR+ patients (6/29, 21%, P = 0.23). Regarding kinetic enhancement curve, malignant-type enhancement occurred in 33 of 36 measured ER+/PR− lesions (29 washout and four plateau) and in 31 of 34 measured ER+/PR+ lesions (27 washout and four plateau). Three lesions in both groups showed the benign-type continuous enhancement curve (P = 1).

The imaging features of ER+/PR+ and ER+/PR− patients are summarized in Table 1. PR status can provide strong prognostic information on the risk of recurrence in endocrine-treated breast cancer patients [5]. ER+/PR− breast cancers are less sensitive to tamoxifen than are ER+/PR+ tumors [6–8]. In postmenopausal women, the ER+/PR− group had a worse disease-free survival and overall survival compared with ER+/PR+ group [8]. It has been shown that the PR status is a better prognostic predictor than the ER status [9].

Correlation of PR with imaging features is rarely studied. In a few studies of positron emission tomography uptake with prognostic factors of breast cancer, controversial results were found regarding impact of PR on maximal standardized uptake value [10–12]. In this study, we found that ER+/PR− cancer has larger tumor size compared with ER+/PR+ cancer, and it is more likely to present nonmass-type lesions. The finding is consistent with previous studies [1, 6].

Table 1. MR imaging features of ER+/PR+ and ER+/PR− patients

<table>
<thead>
<tr>
<th>MR imaging features</th>
<th>ER+/PR+</th>
<th>ER+/PR−</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor size&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.69 ± 1.00 cm</td>
<td>2.35 ± 1.25 cm</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Lesion multiplicity</td>
<td>8/29 (28%)</td>
<td>5/25 (20%)</td>
<td>0.54</td>
</tr>
<tr>
<td>Mass-type lesion</td>
<td>29/29 (100%)</td>
<td>21/25 (86%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Non-mass type lesion&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0/29 (0%)</td>
<td>4/25 (16%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Axillary lymph node</td>
<td>6/29 (21%)</td>
<td>9/25 (31%)</td>
<td>0.23</td>
</tr>
<tr>
<td>Malignant enhancement kinetics</td>
<td>31/34 (91%)</td>
<td>33/36 (92%)</td>
<td>1</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significant difference between ER+/PR+ and ER+/PR− patients was found for tumor size and nonmass-type lesion (P < 0.05).
consistent with that of Arpino et al. [2]. Another study by Ponzone R et al. [3] also showed that PR-negative tumors were characterized by larger size and higher tumor grade.

According to the ACR BI-RADS MRI lexicon [4], nonmass-type lesion indicates that enhancement occurs in an area of the fibroglandular tissue without space-occupying effect. It represents a breast lesion with infiltrative process. In malignant cancer, the infiltrative process might be regarded as an aggressive tumor behavior. However, interpretation of this data should be cautious since there were four patients of lobular cancer included in the ER+/PR− cohort and two of them showed nonmass-type enhancement. If these four patients were excluded, the difference is not significant (2/21 versus 0/29, \( P = 0.17 \)). Other imaging features, including multiple lesions, kinetic enhancement curve, and axillary lymph nodes metastasis, were not significantly different.

In conclusion, in this study we compared the MRI features between ER+/PR+ and ER+/PR− cancers and found that PR-negative cancer had significantly bigger tumor size and more nonmass-type lesions. Our study provides imaging evidence that PR in invasive breast cancer does impact imaging features and PR-negative invasive breast cancer is more aggressive, consistent with findings of several previous studies showing that missing PR in ER-positive breast cancer is more aggressive than its counterpart of ER+/PR+ cancer.

**funding**

National Institutes of Health/National Cancer Institute (R01 CA90437, CA121568); California Breast Cancer Research Program (9WB-0020).

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doi:10.1093/annonc/mdn120
Published online 28 March 2008