Comparison of MR Imaging Features between Estrogen Receptor Positive and Negative Breast Cancers

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Purpose

In vitro studies have shown that estrogen receptor-alpha (ER-alpha) expression in the ER-negative breast cancer cell lines inhibits their proliferation and invasive, metastatic potential. In vivo studies also demonstrated that subsequent to ER-alpha overexpression, down-regulation of vascular endothelial growth factor was observed in tumor xenografts. In addition, these tumors showed an inhibition of vascularization [1]. A study of human breast cancer has found an inverse association between microvascular density (MVD) and ER expression [2]. In study of ductal carcinoma in situ (DCIS), ER was inversely associated with comedo histology and nuclear grade [3]. A higher percentage of VEGF-positive tumor cells were present in ER-negative tumors. These ER-negative tumors were characterized by a higher proliferative activity [4]. Little is known about the differences of MRI features between ER-positive and ER-negative breast cancer. Based on the above research findings, we postulated that breast cancer with different estrogen receptor status might have different MRI features. The purpose of this study is to compare the MR imaging features between ER positive and negative breast cancers.

Methods

Thirty seven ER positive and thirty seven ER negative invasive ductal carcinomas were analyzed in this study. The MRI was performed using a 1.5 T Phillips Eclipse MR scanner with a standard bilateral breast coil. The imaging protocol consisted of high-resolution pre-contrast imaging and dynamic contrast-enhanced axial imaging. After the dynamic scan was completed, subtraction images were created by subtracting the pre-contrast images from the post contrast enhanced images at one minute after the contrast agent injection. The enhancement kinetics was analyzed from pixels of the strongest enhancement region within the lesion. The diagnosis was based on the morphologic and enhancement kinetic features of ACR BIRADS-MRI lexicon. The morphologic criteria included mass lesions and non-mass enhancement types. The evaluation of enhancement kinetic curve was based on initial (within the first 2 minutes or when the curve starts to change), and late phases. The initial enhancement phase is categorized into fast, medium, and slow. The delayed enhancement phase is described as persistent, plateau, and washout. In selected patients, choline quantification by MR spectroscopy was also performed.

Results

Thirty two of ER-positive (32/37) and thirty one of ER-negative (31/37) patients had mass lesions. Four ER-positive patients had focus or foci. One had non-mass patchy enhancement. Six ER-negative patients showed non-mass type lesions including five cases of diffuse enhancement and one patchy enhancement. Five in ER-positive and eight in ER-negative group had multiple lesions. The tumor size in ER-positive group ranged from 4mm to 6cm while that for the ER-negative group was 8mm to 9cm. ER negative breast cancer was bigger at the time of diagnosis (3.44 ± 2.10cm) compared to ER positive cancer (2.18 ± 1.42 cm). While five of ER-positive patients showed axillary lymph nodes metastases, thirteen patients in ER-negative group were found to have axillary lymph nodes. Overall, ER-negative group was more likely to show tumor as diffuse or patchy infiltration (6/37 vs. 1/37), multiple lesions (8/37 vs. 5/37), and axillary lymph node metastasis (12/37 vs. 5/37). No significant difference was found in incidence of bilateral lesions. Table 1 summarizes all comparison results. Fig. 1 illustrates several different types of MR presentations for ER negative breast cancer. In analysis of enhancement kinetic patterns, 3 ER-positive lesions showed medium up-slope followed by persistent enhancement, and other ER + and all ER negative lesions showed the typical malignant type kinetic pattern with fast up-slope followed by wash-out or plateau. For choline detection, two of sixteen ER-positive patients showed detectable choline. For ER-negative patients, seven of nine patients showed detectable choline.

Table 1. Comparison of MR Imaging Features between ER-Positive and ER-Negative Lesions

MR imaging features	Tumor size	Multiplicity	Axillary L.N.	Mass- type lesion	Non mass lesion	Detectable choline
ER – positive (N= 37)	2.18 ± 1.42 cm	5/37 (14%)	5/37 (14%)	36/37 (97%)	1/37 (3%)	2/16 (13%)
ER – negative (N= 37)	3.44 ± 2.10 cm	8/37 (22%)	13/37 (35%)	31/37 (84%)	6/37 (16%)	7/9 (78%)

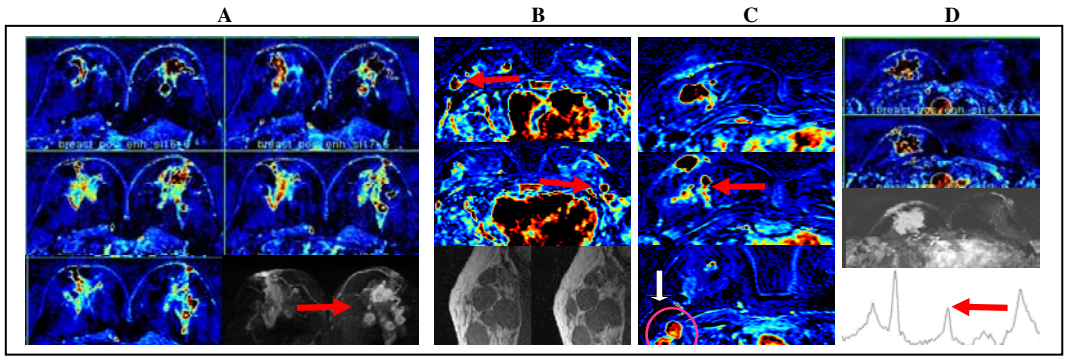

Fig. 1. MR imaging of ER-negative breast cancer. A: Multiple cancers in left breast. B: Bilateral breast cancers with confluent lymph nodes. C: Multiple cancers with lymph nodes. D: Irregular tumor with detectable choline

Discussion

Breast MRI demonstrates different imaging features between ER positive and ER negative breast cancers. ER negative cancer appeared to be more aggressive, with bigger size, more infiltration and multiple lesions, which might be associated with its higher angiogenic activity. The reason why estrogen negative cancer had more axillary lymph node metastasis needs further investigation. It is known that HER-2/neu is predictive of sentinel lymph node, which was not included in our analysis. We found that detectable choline appeared more frequently in ER negative group (78% vs. 13%), which needs to be investigated in more patients. Higher tumor angiogenesis in ER negative breast cancer induces more vigorous proliferation and turn over of cancer cells is postulated. From our preliminary results, MRI is especially recommended for patients diagnosed with ER negative cancer to better define the disease extent, axillary lymph nodes, and presence of multi-foci lesions. This may facilitate a better surgical planning leading to a better prognosis.

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