MR Imaging Features of Triple Negative Breast Cancer

J-H. Chen[1,2], H-M. Baek[1], R. Mehta[3], P. Carpenter[4], O. Nalcioglu[1], and M-Y. Su[1]

[1]Center for Functional Onco-Imaging, University of California Irvine, Irvine, California, United States, [2]Department of Radiology, China Medical University Hospital, Taichung, Taiwan, [3]Department of Medicine, University of California Irvine, Irvine, California, United States, [4]Department of Pathology, University of California Irvine, Irvine, California, United States

Background and Purpose

Triple negative (TN) breast cancers refer to those with negative estrogen receptor (ER), negative progesterone receptor (PR), and negative HER2. TN breast cancers account for about 24% of all types of breast cancers [1]. About 85% of TN phenotypic breast cancers are deemed to be basal-like, and have a clinical behavior similar to basal-like tumors [2]. TN tumors were aggressive, and were usually diagnosed at a later stage. The most common histological types for TN breast cancer were invasive ductal carcinomas, and metaplastic carcinomas that have mixed cancer types. Histologically, TN cancers are poorly differentiated, mainly of high histologic grade and with high mitotic index. Imaging features of this clinically important subtype of breast cancer are rarely studied and not well known. This study is aimed towards analyzing its MR imaging features.

Materials and Methods

A review of our breast MRI database with available ER, PR, and HER-2 biomarkers from 2002 to 2006, 29 pathologically proven TN breast cancer patients (25-82 years old, mean 50, median 46) were identified and analyzed. Twenty-five patients (25/29, 86%) were diagnosed with pure invasive ductal carcinoma and 4 patients (14%) were metaplastic breast cancer, including three with ductal and squamous components and one with ductal and chondroid components. The MRI study was performed on a 1.5 T Phillips Eclipse MR scanner with a standard bilateral breast coil. After mid-2005, nine patients also received single-voxel proton MR spectroscopy for detection and quantification of choline, using point-resolved spectroscopic (PRESS) sequence for volume localization. The imaging protocol consisted of pre-contrast sagittal view T1-weighted imaging and dynamic contrast-enhanced axial 3D SPGR (RF-FAST) T1-weighted imaging. The sequence was repeated 16 times, four pre-contrast, and 12 post-contrast sets after injection of Omniscan® (1 cc/10 lbs body weight). After the dynamic scan was completed, subtraction images and the maximum intensity projections (MIPs) were generated for tumor size measurements. The enhancement kinetic time course was analyzed from enhanced areas shown on subtraction image at 1-min after injection. The lesion morphology and enhancement kinetic features were defined according to the ACR BI-RADS MRI lexicon. The morphologic criteria included mass type lesion (focus/foci (smaller than 5mm), mass (greater than 5 mm)) and non-mass type of enhancement (focal area, linear, ductal, segmental, regional, multiple regions, diffuse enhancement). The evaluation of enhancement kinetic curve was based on initial (within the first 2-min or when the curve starts to change), and late phases (after 2-min or after the change). The presence of skin enhancement of the breast, and enlarged axillary lymph nodes were also recorded.

Results

Table 1 summarizes the MR imaging features in these 29 patients. Overall, 6 patients (21%) were T1 stage, 12 (41%) were T2, and 11 (38%) were T3 or above. Tumor size ranged from 4mm to 10cm (4.1 ± 2.7 cm). One patient had bilateral breast cancer and 6 patients (21%) had multiple cancer foci in the same breast (Fig. 1). Except for one patient presenting with a non-mass type of regional enhancement, all other twenty-eight (97%) had mass type lesions. Ten patients (35%) showed prominent skin enhancement (Fig. 2). Their tumor size was larger than 5cm, which raised the suspicion of dermal lymphatic invasion. Rim enhancement (Fig.3), a specific sign of malignancy on breast MRI, was identified in 12 patients (41%). Twenty-two lesions had documented enhancement kinetic curves, and all showed the typical malignant kinetic feature with rapid up-slope followed by washout (100%). The morphological and kinetics features are in accordance with MR imaging features of invasive ductal carcinoma. Fourteen patients (14/29, 48%) showed identifiable lymph nodes in the axillary region (Fig.4). Nine patients had MR spectroscopy and 7 of them (78%) showed positive choline level ranging from 0.4 to 4.9 (mean 2.6) mmol/kg.

Table 1. MR Imaging Features of Triple Negative Cancers

Characteristics	Patients	%
Tumor T staging		
T1 (< 2cm)	6	21%
T2 (2-5 cm)	12	41%
T3 and above	11	38%
Lesion multiplicity		
Single lesion	23	79%
Multiple lesions	6	21%
MR morphology		
Mass type lesion	28	97%
Non-mass type lesion	1	3%
Skin enhancement		
Yes	10	34%
No	19	66%
Rim Enhancement		
Positive	12	41%
Negative	17	59%
Kinetic enhancement features		
Rapid up-slope and washout	22/22	100%
Slow and continuous enhancement	0	0%
Axillary lymph nodes		
Positive	14	48%
Negative	15	52%
Choline detection (N=9)		
Positive	7	78%
Negative	2	22%

T1: tumor ≤ 2cm, T2: 2cm < tumor ≤ 5cm, T3: tumor > 5cm

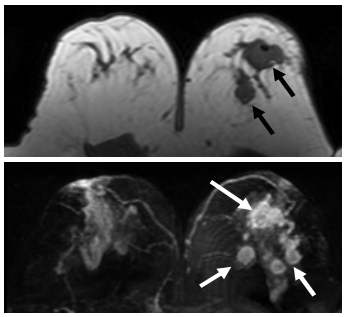

Fig. 1. A TN cancer in the left breast with multiple tumor foci.

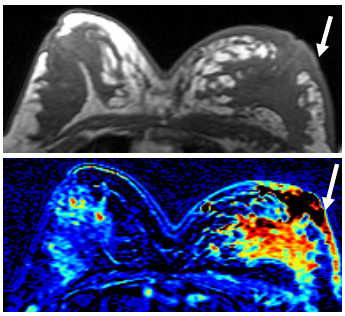

Fig. 2. A large TN tumor in the left breast with skin invasion.

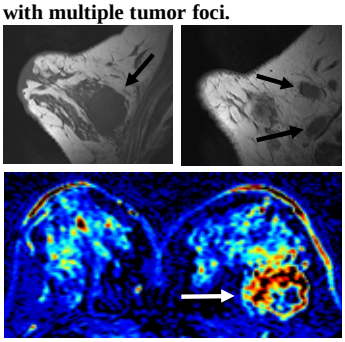

Fig. 3. A TN cancer of single lesion in the left breast with rim enhancement and axillary lymph nodes.

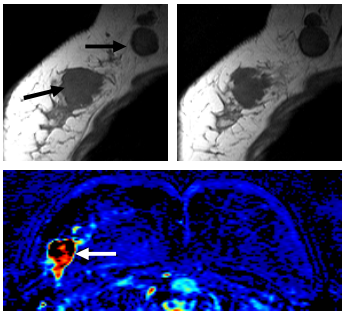

Fig. 4. A TN cancer of single tumor lesion in the right breast with axillary lymph nodes metastasis.

Conclusion

In conclusion, our preliminary observation showed that most of TN breast cancers were mass type lesions, which was dominated by their ductal phenotype with typical malignant enhancement kinetics on MRI. Nearly 80% of our TN patients showed T2 tumor staging or higher, which was comparable to other reports. The average tumor size was above 4cm and nearly 50% of patients showed axillary lymph nodes metastasis. These features indicate their aggressive malignant behavior and possibly associate with worse outcome.

References: 1. Haffty BG, et al. Locoregional relapse and distant metastasis in conservatively managed triple negative early-stage breast cancer. J Clin Oncol. 2006; 24(36):5652-7. 2. Rakha EA et al. Prognostic markers in triple-negative breast cancer. Cancer. 2007; 109(1):25-32.

Acknowledgement: This work is supported in part by NIH CA90437 and CBCRP 9WB-0020 and 12FB-0031.