Correlation of Prognostic Parameters and MR Perfusion Parameters in Dynamic Contrast Enhanced MRI (DCE-MRI) in Patients with Breast Cancers

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PURPOSE

DCE-MRI allows noninvasive measurement of microvascular permeability and perfusion. We evaluated whether the perfusion parameters from DCE-MRI were correlated with prognostic parameters in breast cancer patients.

MATERIALS AND METHODS

Twenty patients (mean 51; range 35-78 years) with 20 breast cancers (18 IDC, 1 DCIS, 1 invasive lobular carcinoma) underwent DCE-MRI with a 1.5 T machine and 8-channel breast coil. A total of 42 phases of dynamic series with 11 second temporal resolution were obtained using 3D fast SPGR (TR/TE/FA=3.71ms/1.78ms/20, matrix=256x256, FOV=280mm, slice thickness=2mm). Gadobutrol 0.05mmol/kg was injected with an auto-injector in 3cc/sec. Signal intensity-time curve was converted to concentration-time curve through T1 mapping obtained from 3 different flip angles (3, 10, and 17 degree). Kinetic parameters (transfer constant; Ktrans and backflow compartmental rate constant; Kep) based on Toft modeling were obtained with nonlinear Levenberg-Marquardt least-squares fitting algorithm using an internal mammary artery as arterial input function. Ktrnas and Kep values were correlated with tumor size, axillary lymph node status, nuclear grade, histologic grade, ER, PR, p53, HER-2/new, Ki-67 after surgery with Pearson and Spearman correlation tests.

RESULTS

Mean Ktrans was significantly higher in tumors with large size (P=0.019, r=0.521) or higher histologic grade (P=0.018, r=566). Ktrans was independent of the axillary lymph node status (P=0.785). However, tumors with axillary lymph node metastases (n=4) had a slightly higher Ktrans (1.278/min vs. 0.571/min) than those without metastases (n=16). Other prognostic factors such as nuclear grade, estrogen receptor, progesterone receptor, p53, HER-2/new, Ki-67 showed no significant correlation with the kinetic parameters.

CONCLUSION

Transfer constant obtained from DCE-MRI are well correlated with tumor size and histologic grade of breast cancer, which shows its potential as a noninvasive prognostic parameter in the breast cancer patient.

Table 1. Relationship between the Ktrans, Kep and Parameters

Parameters	Ktrans		Kep	
	P-value	$r^{\dagger}$	*P*-value	$r^{\dagger}$
Tumor size	0.019*	0.521	0.057	0.432
Axillary LN	0.785	0.065	0.928	0.022
HG	0.018*	0.566	0.146	0.368
NG	0.325	0.239	0.935	0.020
ER	0.372	-0.211	0.829	-0.052
PR	0.809	-0.058	0.937	0.019
P53	0.896	0.031	0.396	-0.201
HER-2/new	0.839	-0.048	0.248	-0.271
Ki-67	0.407	0.196	0.905	-0.028

*Statistical significance was established at P<0.05.

† r is a correlation coefficient within -1 to +1

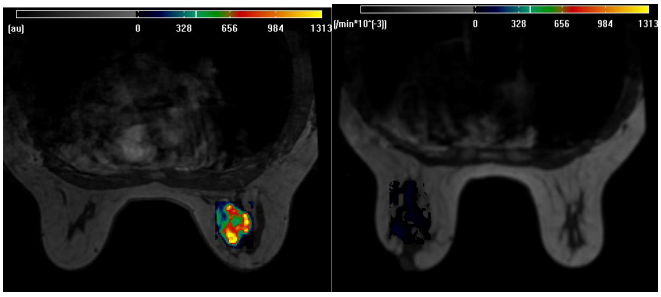

Fig A. Permeability map image shows breast cancer (yellow to green) in the right breast with mean Ktrans value 1.263/min±0.188. Surgical histology revealed 3.3cm IDC with high histologic grade.

Fig B. Permeability map image shows a cancer (blue) in the left breast with mean Ktrans value 0.092/min±0.017. Surgical histology revealed 0.5cm IDC with low HG and surrounding 6cm DCIS.