Can we distinguish breast cancer from mimicking lesions using combined evaluation with proton MR spectroscopy and dynamic-contrast -enhanced MRI?

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Introduction: Breast MR is a valuable method of evaluating the breast disease in a variety of clinical situations. Time-signal intensity curves of lesions generated from Gadolinium (Gd) enhanced dynamic MR imaging, which was a clue of tumor angiogenesis, have provided high diagnostic value for invasive cancer differentiating from benign tumors. Proton MR spectroscopy at 1.5T (1H-MRS) has also demonstrated its high specificity concerning malignant tumor having choline peak. Combined analysis of dynamic MRI and 1H-MRS might enhance diagnostic utility of MR about breast tumor. The purpose of our study was to evaluate whether breast tumor with combined evaluation of dynamic MRI and 1H-MRS was useful.

Methods: From October 2006 to September 2007, among 203 consecutive patients who underwent breast MRI using 1.5T unit (SIGNA HDe, GE) with 4-channel breast phased array coil, 61 female patients (age range: 25-86, mean age 56 years old) with the breast lesions larger than 1cm in diameter (range 10-90 mm, mean 26 mm), which pathological diagnoses were confirmed by biopsy or surgery, were included in this study. All patients underwent T1-weighted 3D gradient echo sequence (VIBRANT, GE; transverse 1.5mm partitions, TR/TE: 7.5/3.4 ms, FA= 15 degree, FOV 35cm, matrix 512/320, 0.1 mmol/ kg Gadodiamide, 1 pre and 3 postcontrast phases acquired at every 60 seconds), and Single-voxel water-suppressed TE-averaged PRESS1H-MRS with eliminating spurious lipid sidebands (BREASE GE; TR/TE = 1500/155 ms, number of average: 24, FOV: 16cm,Voxel size: larger than 10*10*10 -20*20*20mm optimized as tumor size). With 3D gradient echo images, the time signal intensity curves of lesions were plotted. We categorized the patterns of the time signal intensity curve into 3 types as follows; type 1: monotonic increase in signal intensity (SI) over examination period (monotonic pattern), type 2: rapid increase in SI, which peak is maintained at the late period (plateau pattern), and type 3: rapid increase in SI, which peak decrease at the late period (washout pattern), respectively. Concerning existence or absence of a choline peak, all 1H-MRS data were interpreted by radiologists with a blind fashion.

Results: All data were adequate for analysis. Pathological diagnosis showed 48 malignancies and 13 benigncies (invasive ductal carcinoma: n = 43, non-invasive cancer: n = 2, mucinous carcinoma: n = 3, papilloma: n = 2, fibroadenoma: n = 5, phyllodes tumor: n = 1, duct ectasia: n = 1, mastisitis: n=1, hamartoma: n=2, and adenomyoepithelioma: n = 1, respectively). The results are summarized in Table 1. The time signal intensity curves of two mucinous carcinomas were categorized into type 1, which has a choline peak. On the other hand, two benigncies (one case of mastitis and adenomyeloepithelioma, respectively) showed type 3 curve, and had a choline peak.

Discussion: In our results, there were 11 false positive and 8 false negative lesions on 1H-MRS, and the 29 lesions categorized into type 1 or type 2 curves generated from dynamic contrast enhanced MRI, which proved to be malignancies. Certain overlaps such as benigncies having microhemorrhage and / or necrotic parts, inflammations which behavior mimicked breast cancer and little amount of malignant tumor having massive reactive fibrosis that showed like benign tumor might be present. Furthermore, technical failure such as missing voxel settings on 1H-MRS might be occurred in some cases.

Conclusion: Although time signal intensity curve with dynamic contrast enhanced MR imaging and existence of a choline peak on 1H-MRS are suggested malignant breast tumor, overlaps and technical failure should be taken into consideration.

Table 1. Combined evaluation with 1H-MRS and time signal intensity curve on 3D dynamic MR images

Time signal intensity curve	Type1 (monotonic)		Type2 (plateau)		Type3 (washout)	
1H-MRS	Choline peak		Choline peak		Choline peak	
	Negative	Positive	Negative	Positive	Negative	Positive
Malignancies	4	10	2	13	4	15
Benigncies	1	8	1	1	0	2