# COMBINED 2D MR SPECTROSCOPY AND DYNAMIC CONTRAST ENHANCED MRI FOR BREAST CANCER DETECTION

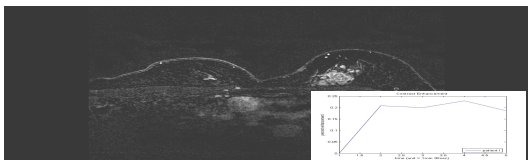
S. L. Lipnick[1], X. Liu[1], and A. Thomas[1]

[1]Radiology, University of California, Los Angeles, Los Angeles, CA, United States

**Introduction**:
Dynamic Contrast Enhanced (DCE) Breast MR imaging is emerging as the most sensitive modality that is currently available for the detection of breast cancer. However, the reported specificity of DCE-MRI has been variable, ranging from 37% to 97%, resulting in many unnecessary biopsies of benign lesions (1). There is a need to improve detection specificity. Studies of breast cancer cell lines and breast tumors have consistently shown that choline (Cho) is elevated in malignant lesions (2). Recent studies show Cho can be detected in malignant breast tissue using single-voxel (SV) proton MR spectroscopy (3), which demonstrated the promise for the differentiation of benign and malignant lesions based on detection of Cho(4). The purpose of this pilot study was to combine DCE-MRI analysis with localized two-dimensional MR correlated spectroscopy (2D L- COSY) in order to increase the specificity of breast cancer detection

**Methods:** 9 women with invasive ductal carcinomas (mean age 51 years old), 2 women with benign lesion (mean age 30 years old), and 13 healthy women (mean age 43 years old) were investigated, 2 data sets were not used due to technical errors involving shimming of the magnetic field (1 malignant and 1 healthy). All scans were performed on a 1.5T Avanto whole body MRI/MRS scanner (Siemens Medical Systems, Erlangen, Germany). A dedicated siemens phased arrayed breast coil was used to acquire the data. DCE MRI sequences was performed using an axial T1-weighted fast three-dimensional spoiled gradient recall echo (3D SPGR) sequence, (TR=4.06 msec, TE=1.47msec, flip angle=10, FOV=18x18 cm, matrix size=512x512, slice thickness = 1.7-2.5mm). Gadolinium contrast was delivered intravenously at a rate of 2mL/sec. 2D L-COSY spectra were recorded using the following parameters: TR of 2 seconds, TE of 30 msec, 45 increments of $\Delta t1$, and 8 excitations per $\Delta t1$. The raw data were acquired using 1024 complex points and 2000 Hz spectral width along the first dimension (F2) and 625 Hz along the second dimension (F1). The RF pulse sequence included three slice-selective pulses ($90^0$-$180^0$-$90^0$) to localize a desired voxel. The last $90^0$ pulse also acted as a coherence transfer pulse for 2D L-COSY. Spectra were acquired from localized volumes of interest (VOI) in each subject's breast tissue. The size of each VOI was 10x10x10$mm^3$ for all scans.

**Results and Discussions:** Our pilot study shows the feasibility of combining DCE-MRI with 2D L-COSY to detect the breast cancer. After analyzing the enhancement pattern types from DCE-MRI, lesions that would have shown previously uncertain results (type 2=plateau enhancement) now can been differentiated through the combination of DCE-MRI and 2D L-COSY. Figure 1, A shows the enhancement curve from the malignant lesion shown in the MRI, B shows the associated 2D spectrum. Figure 2, A shows the enhancement curve from the benign lesion shown in the MRI, B shows the associated 2D spectrum. Both lesions show type II enhancement curves and cannot easily be distinguished using DCE-MRI alone, however, the associated 2D spectra from the malignant lesions shows a choline peak while the benign does not. Table 1 shows the diagnosis and sensitivity and specificity from our pilot results.



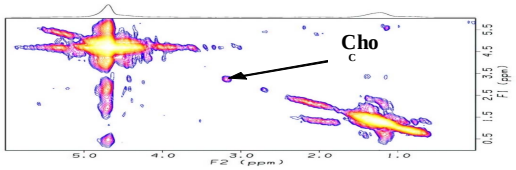
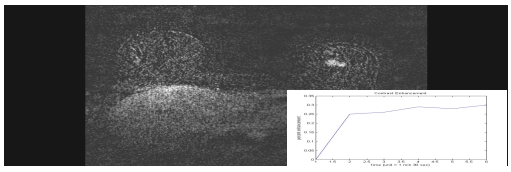



Figure 1: A ) B )



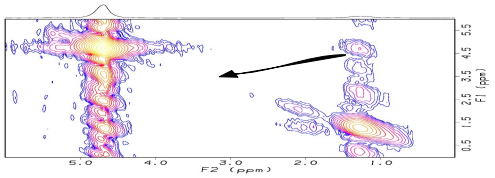



Figure 2: A) B)

**Table 1**

| | Malignant | Benign | Healthy | | | |
|---|---|---|---|---|---|---|
| **Diagnosis** | 8/9 | 2/2 | 13/13 | **Sensitivity** | = | 89% |
| | | | | **Specificity** | = | 100% |

**Conclusions:** We have evaluated sensitivity and specificity of breast cancer detection using DCE-MRI combined with 2D L-COSY. We found that the sensitivity is high (89%) and that including 2D L-COSY increases the specificity to 100%. This is in agreement with previous studies that have shown choline can be used as a clinical marker for malignancy. These pilot findings need to be evaluated using a large cohort of breast cancer patients.

**References:**
1 Kuhl CK. Radiology 2007; 244(2):356-378.
2 MacKinnon WB, Barry PA, Malycha PL. Radiology 1997; 204: 661-666.
3 Thomas MA, Binesh N, Yue K, Debruhl N. Journal of Magnetic Resonance Imaging 2001;14:181-186 .
4 Jacobs MA, Barker PB, Phil D, Argani P, Ouwerkerk R, Bhujwalla ZM, Bluemke DA, Journal of Magnetic Resonance Imaging 2005; 21:23-28.