# The Value of $^1$H MRS in Improving Clinical Assessment for the diagnosis of Breast Cancer: A Clinical Blind Study at 4 Tesla

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**Introduction:** Approximately 75% of mammographically detected breast lesions in which fine needle aspiration or surgical biopsy was performed ultimately proved to be benign(1). It has been reported that the sensitivity of MRI in detecting breast lesions ranges from 95-100% (2) but MRI of the breast has been shown to have variable specificity. There have been many published reports showing that *in vivo* MR spectroscopy (MRS) can be useful in distinguishing benign from malignant breast lesions and therefore, can improve the specificity of breast MR (3-7). However, there are currently no published reports that examine the value of MRS on a clinician's assessment for patient's who are being evaluated for breast cancer. For this reason, we conducted this study to investigate whether the addition of MRS to MRI can improve the accuracy of a radiologist's assessment.

**Materials and Method:** Fifty eight women (ages 31-71) with suspicious mammographic or ultrasound findings who were scheduled for biopsy were recruited for our study. All studies were done with a 4T MRI/MRS scanner. Informed written consent was obtained prior to all studies. Each patient received an MR scan prior to biopsy. Suspicious lesions scheduled for biopsy were identified and measured with a fat-suppressed high resolution 3D FLASH image and by evaluating dynamic contrast uptake (Gd -DTPA, 0.1 mmol/kg). Criteria for MRS voxel placement was based on lesion architecture, dynamic contrast uptake, and prior clinical knowledge from mammographic or ultrasound images. Single-voxel spectroscopy was performed with TE averaging (TE=45-196ms in 128 increments) (8). Tissue concentrations of choline-containing compounds ([tCho]) were quantified by fitting the data to a Voigt lineshape model and using unsuppressed water as an internal reference (9). Three breast radiologists (FK, BL, and DC) from different institutions who specialize in breast MR were then asked to retrospectively evaluate all 58 cases in random order on a mock work station. All 3 readers were unaware of the patient's histological diagnosis and each reader was provided with an ROC curve analysis for the quantification of the [tCho] measurements. For each patient, readers were initially provided with just the MR images and time course data and asked to give their assessment. Once this step was completed, each reader was then provided with the MRS results and asked to re-evaluate their assessment for patient management. Reader accuracy was based on the improvement of sensitivity and specificity, after the addition of MRS, and how it corresponded to reducing both the number of missed cancers and unnecessary biopsies on benign lesions.

**Results:** Twenty nine patients had invasive ductal carcinoma (IDC), 5 had invasive lobular carcinoma (ILC), 1 patient had mixed IDC and ILC, and 23 patients were found to have benign breast lesions. A summary of the reader's results are provided in table 1. The addition MRS to MRI improved the sensitivity and reduced the number of missed cancers. However, only 2 of 3 readers improved in specificity and the reduction of unnecessary biopsies.

**Conclusion:** Based on our results, it appears that the addition of MRS to MRI may provide an improvement in sensitivity and specificity by guiding the reader in distinguishing between benign and malignant breast lesions. Furthermore, for difficult diagnoses where MRI is ambiguous, MRS can be incorporated to improve the breast radiologist's assessment by reducing the number of missed cancers and unnecessary biopsies. Overall, the results of this study support the hypothesis that MRS is a valuable addition to MRI for the clinical assessment and diagnosis of breast cancer.

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| Reader | Sensitivity % | Specificity % | Missed Cancers | Unnecessary Biopsies |
|---|---|---|---|---|
| 1 | 57→83 | 82→79 | 15→6 | 4→5 |
| 2 | 86→91 | 48→57 | 5→3 | 12→10 |
| 3 | 91→94 | 22→30 | 3→2 | 18→16 |

**Table 1:** The data on the left side of the arrow represent the results from using just MR morphology and time course. The data on the right side of the arrow represent the results from MR morphology, time course, and the addition of MRS

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