Multinuclear and Multiparametric MR imaging as an early treatment response biomarker for preoperative systemic therapy in breast cancer:Preliminary Results

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INTRODUCTION: Our purpose was to *prospectively* investigate the feasibility of developing radiological biomarkers using dynamic contrast enhanced magnetic resonance imaging(DCE-MRI), spectroscopy (MRS), and sodium imaging (^{23}NA) before (baseline) and after preoperative systemic treatment (PST) for monitoring treatment response of locally advanced breast cancer(LABC). Multiparametric and multinuclear MRI makes it possible to non-invasively image radiological biomarker information of breast lesions as potential early predictive markers of response [1].

METHODS: Patients with LABC undergoing PST with an anthracycline-based regimen were studied before and after treatment. MR data were acquired consisting of fat-suppressed(FS) T_2 spin echo(TR/TE=5700/102) and T_1-FSPGR (TR/TE=200/4ms) images. DCE-MR contrast agent(Gd-DTPA;0.1mmol/kg) was administered, and 3D FS-T_1-FSPGR (TR/TE=20/4) pre-and post-contrast images were obtained. Water-suppression was accomplished with "CHESS" pulses, and lipid suppression using a STIR pulse(TI=171ms) and MRS was obtained using PRESS(TR/TE=2000/280ms)[2]. ^{23}Na images were obtained with TIP (TE/TR=0.4/120ms)[3]. Total data acquisition time was about 45 min. After PST, patients had a mastectomy or lumpectomy with pathological assessment of tumor response. Volumes were obtained with a semi-automated segmentation algorithm. Signal to noise ratios (SNR) were obtained from the choline peak(3.2ppm). Quantitative estimates (mMol/l=mM) of total sodium content(TSC) were made by external reference technique. Descriptive statistics are presented as mean and standard deviations.

RESULTS: We studied eighteen patients receiving PST. There were 15 responders; 4 (22%) complete pathological responders (cPR) and 11 (61%) partial pathological responders (pPR)-figure 1, and 3(17%) non responders(nPR). Lesion volume decreased in all groups with the largest decrease in the responders (86 to 53mm^3) and nPR (94 to 75 mm^3) after the first cycle. Responders had the largest reduction in the choline SNR (7.5±2.5to 4.5±1 p<0.05) compared to nPR (8.9±2.2 to 6.9±2.1). Sodium concentration significantly decreased in responders (62.8±18 to 48.8±8mM;p<0.05), however, there was an increase (57.7±7.6 to 56.5±1.5) in the TSC for the non-responders(graph). **DISCUSSION**: Sodium concentration and choline SNR were significantly changed after PST in responders. These finding confirm previous reports in a similar set of patients and *extend these results* to include multinuclear studies [4-6]. Combining these MR methods will enable us to potentially devise new radiological biomarkers (Choline and TSC) that will improve our understanding of the factors affecting efficacy of PST intervention and yield potentially useful information to guide therapy in breast cancer patients.

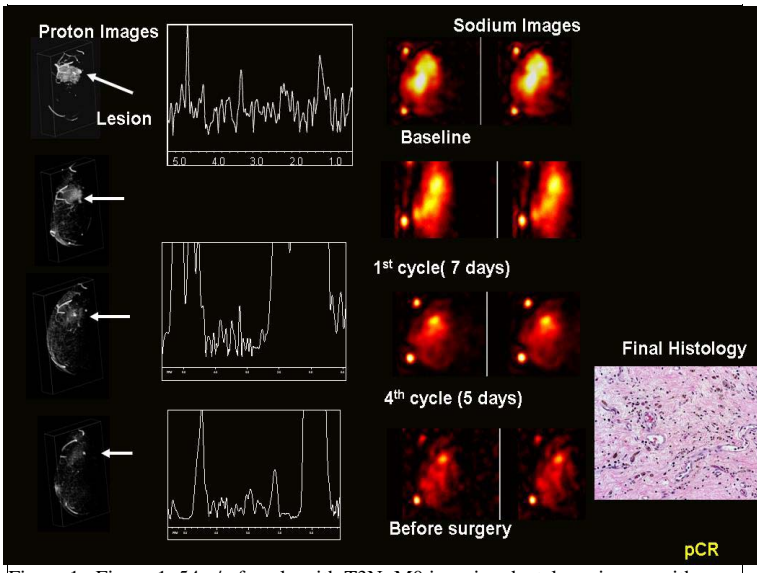

Figure 1. Figure 1. 54 y/o female with T3NoM0 invasive ductal carcinoma with a complete pathological response.

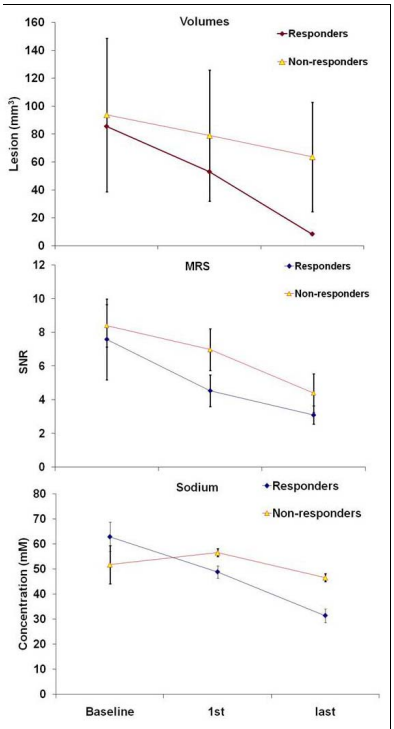

Fig. 2Graphs of the changes in volume, choline, and Total Sodium Concentration

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