

Multiparametric Proton and Sodium MRI of Uterine Fibroids Pre- and Post-treatment

M. A. Jacobs¹, R. Ouwerkerk¹, P. A. Bottomley¹, H. S. Kim¹

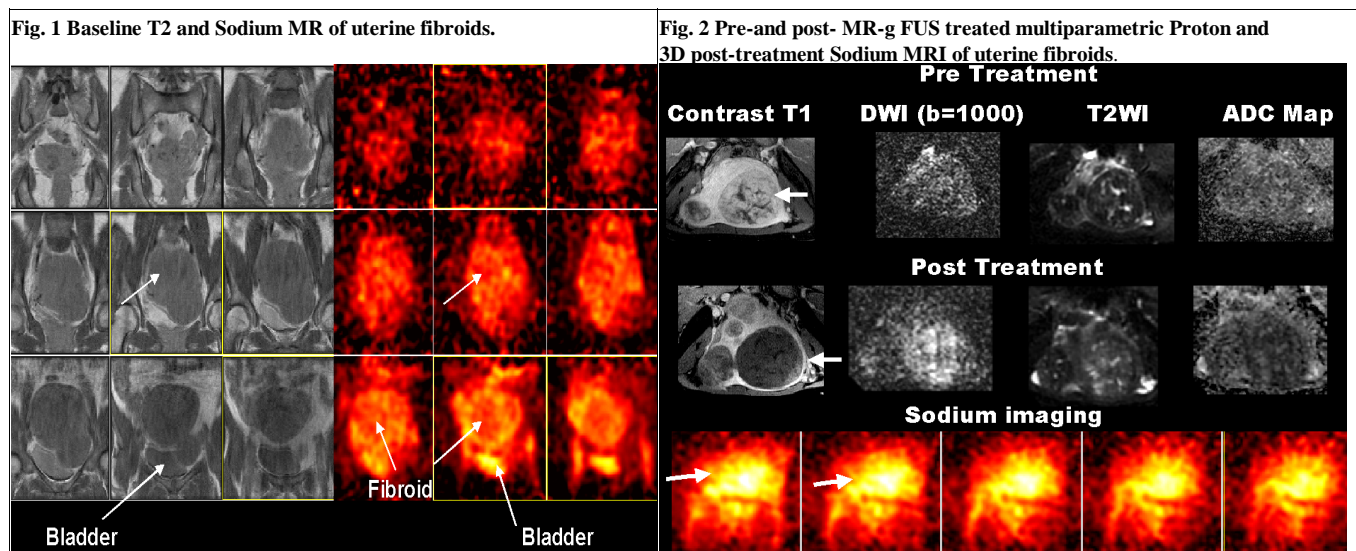
¹Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States

INTRODUCTION: Current treatments for benign uterine leiomyomata (fibroids) include medical, surgical, and minimally-invasive treatments. Minimally-invasive treatments include Uterine Fibroid Embolization (UFE) and MRI-guided thermal ablation with focused ultrasound (MR-g FUS) [1-4]. Without pathologic results, it is difficult to assess true effects and success of minimally-invasive treatments on uterine fibroids. Monitoring the treatment with diffusion-weighted MRI (DWI) and sodium MRI could provide new insights into the pathophysiology of uterine fibroids and prove useful for assessing the success of treatment. We report here initial findings on the use of DWI and sodium (²³Na) MRI before and after MR-g FUS or UFE treatment for symptomatic uterine fibroids.

METHODS: Eight patients (median age=43±6 yrs) with uterine fibroids (median size 5.2±3.0cm) were studied by contrast MRI (T1 FSPGR, TR/TE=185/1.5ms, 256x100, 28x28, ST=6mm) DWI (TR/TE=5000/90ms, b=0,500-1000, 128x128, 28x28, ST=6mm) before and immediately after UAE or HIFUS treatment, with a GE 1.5 T system. In addition, baseline and/or post-treatment MRI scans were obtained in five patients using T2 weighted and a 12 min ²³Na MRI scan (Twisted Projection Imaging; TR/TE =120/0.4ms, 718 projections, 400 μs adiabatic half passage excitation, 40 cm surface coil) [5]. Regions of interest were drawn on the post-contrast images and localized to areas of DWI hyperintensity, and to sodium images. Absolute [Na] was quantified using a concentration reference [5]. Statistical comparisons of pre, post, and non-treated uterine tissue were performed using ANOVA.

RESULTS: Pre-treatment DWI and ²³Na MRI scans did not reveal any significant differences between tumor and surrounding tissue (Figs 1 and 2). After treatment, all MRI scans show considerable changes in the treated areas: specifically, elevated signal in DWI and ²³Na MRI. Figure 2 demonstrates pre-treatment T1 contrast, DWI, T2-weighted, apparent diffusion constant (ADC) map and ²³Na MRI. For patients, Mean lesion ADC appeared lower than in non-treated lesions (1437±230 vs 1792±543, p=ns) with an ADC ratio=0.82. Median [Na] in uterine tissue was 28±5.5 μmol/g wet wt before treatment vs 43.2 ±9.3 post treatment (p=0.05).

DISCUSSION: We demonstrated for the first time quantitative DWI and ²³Na MRI in uterine fibroids before and after treatment. A lower ADC compared with surrounding tissue could be consistent with tissue necrosis and/or protein denaturation associated with treatment. ²³Na MRI reflects cell ionic status and membrane permeability, and the elevations of sodium following treatment are also consistent with membrane disruption as a response to therapy. We continue to monitor these changes with follow-up studies to evaluate the potential role of DWI and ²³Na MRI as potential correlates of therapeutic response.



REFERENCES: [1] Cline HE, *MRM*. 1993;30:98-106. [2] Hynynen K, *Radiology* 2001;219:176-85. [3] McDannold, *JMRI* 1998;8:91-100.[4] Tempany M, *Radiology* 2003;226:897-905 [5] Ouwerkerk R. *7th Ann. SCMR*, 2004, 435

Work supported by NIH grants: P50CA103175, R01CA100184, and R01HL61695. We thank Diane Reyes and InSightec for assistance