Evaluation of Chronic Cryoablated Prostate Lesions by Diffusion-weighted MRI

Jing Chen1,2, Donna Bouley3, Bruce Daniel2, Maurice van den Bosch2, Kim Butts Pauly2
1Dept. of Electrical Engineering, 2Dept. of Radiology, 3Dept. of Comparative Medicine, Stanford University, USA

Introduction

Cryoablation has been shown to be a promising treatment method for prostate cancer. Our group has demonstrated that diffusion-weighted MRI (DWI) provides delineation of the acute cryo lesion from normal untreated prostate tissue (1, 2). This is particularly useful because, unlike contrast enhanced imaging, the method is repeatable. In this work, we further investigate the use of DWI to evaluate chronic prostate lesion after cryoablation.

Methods and Materials

All animal experiments were approved by the Administrative Panel on Laboratory Animal Care. MR-guided cryoablation was performed on 3 dogs to create two distinct cryo lesions in each dog. The lesion in the right lobe was frozen slowly to ~ -10°C once ("soft" freeze), while the lesion in the left lobe was rapidly frozen twice to lower than -40°C ("hard" freeze). After the procedure, the dogs survived for 4 days, 14 days and 53 days, respectively. All MR imaging were performed on a 0.5T Signa SP open MRI system (GE, Milwaukee, WI). Line scan diffusion-weighted imaging (LSDI) (3) was used as the DWI sequence (TE/TR = 70/120 ms, matrix = 256 × 63, field of view = 24 × 6 cm, LSDI inclination angle = 70°, band width = 3.81 kHz, effective slice thickness = 5 mm, b = 10, 380 seconds/mm²). The follow-up MR imaging evaluation was performed with identical imaging parameters as for the treatment day.

Results

As shown in previous research, the acute cryo lesions appeared as low ADC values. Over time, the initially low ADC values increased. The rate of the increase depended on the freezing protocol used.

![Graph showing ADC values over time with different freezing protocols]

In this work we report on an experimental study of the evaluation of chronic cryo lesions in the canine prostate with DWI. At each time point, the lesion appeared differently on the ADC trace map from low ADC in the acute lesion, to high ADC in the regenerated gland. In summary, diffusion-weighted MRI could provide insight into the evolution of the tissue following cryoablation. Combining the results from DWI and contrast-enhanced MRI (CE) might contribute to a comprehensive evaluation of the treatment.

Conclusion and Discussions

In this work we report on an experimental study of the evaluation of chronic cryo lesions in the canine prostate with DWI. At each time point, the lesion appeared differently on the ADC trace map from low ADC in the acute lesion, to high ADC in the regenerated gland. In summary, diffusion-weighted MRI could provide insight into the evolution of the tissue following cryoablation. Combining the results from DWI and contrast-enhanced MRI (CE) might contribute to a comprehensive evaluation of the treatment.