AbstractID: 6649 Title: MRI-Controlled Transurethral Ultrasound Therapy for Prostate Cancer

Purpose: To develop and test a transurethral ultrasound therapy system which uses quantitative real-time MRI temperature feedback to control the shape of the coagulated region within the prostate while sparing surrounding structures from thermal damage.

Method and Materials: An MRI-compatible transurethral heating applicator comprised of planar ultrasound transducers that produce a directional heating pattern has been constructed. This device is rotated within a 1.5T MR imager to distribute energy to targeted regions of the prostate by an MRI-compatible motor, concurrent with imaging. The region of the prostate to be treated is selected based on MR imaging information. Subsequent heating is controlled by MRI temperature images acquired every 5s and a complete prostate volume can be coagulated with a single rotation in about 20m. In-vivo experiments have been performed in a canine model and the spatial accuracy of the coagulation patterns has been assessed using contrast-enhanced MR images and a novel, quantitative whole-mount histology technique with image registration to the MR temperature maps.

Results: Sufficient spatial resolution and temperature accuracy can be obtained at 1.5T to provide accurate feedback control of the coagulation pattern within ±1.5mm of the targeted heating radius. Histological analysis indicates that, under these treatment conditions, the margin between completely coagulated tissue and apparently undamaged tissue is ≤3mm in this acute assay. These histological boundaries, when registered carefully with the quantitative MRI temperature histories, provide a good estimate of the temperature threshold (54.6±1.7ºC) for complete coagulation. The contrast-enhanced MR images clearly show the coagulated region but register less accurately with the histological boundaries.

Conclusion: Successful control of transurethral ultrasound therapy using quantitative, real-time MRI temperature images has been demonstrated in vivo. This technology offers good potential for an effective treatment for localized prostate cancer with reduction in morbidity.

Conflict of Interest (only if applicable):