AbstractID: 11935 Title: Catheter-based Ultrasound Technology for Image-guided Hyperthermia and Thermal Ablation

Catheter-based ultrasound applicators have been developed for delivering hyperthermia and thermal ablation for the treatment of cancer and benign diseases. This technology includes interstitial applicators for tumor ablation and hyperthermia delivery during brachytherapy, transurethral devices for conformal prostate hyperthermia and ablation, and an endocavity applicator integrated with an HDR ring applicator for intrauterine hyperthermia. The common design incorporates arrays of multiple ultrasound transducers which provide dynamic axial and angular control of hyperthermia and thermal ablation. Performance was evaluated in phantom, excised tissue, i*n vivo* experiments in canine prostate under MR temperature monitoring, clinical hyperthermia, and 3D-biothermal simulations with patient specific anatomy. Interstitial and endocavity devices can tailor hyperthermia to large treatment volumes, with multi-sectored and multi-transducer power control useful to limit exposure to rectum and bladder. Transurethral applicators include curvilinear transducers with rotational sweeping of focused heating patterns, and multi-sectored tubular devices capable of dynamic angular control without applicator movement. Curvilinear transurethral produce target conforming coagulation zones that can cover either the whole gland or defined focal regions. Multi-sectored transurethral applicators can dynamically control the angular heating profile and target large regions of the prostate without applicator manipulation. High-power interstitial implants with directional devices can be used to effectively ablate defined target regions while avoiding sensitive tissues. MR temperature monitoring can effectively define the extent of thermal damage and provided a means for real-time control of the applicators. Preliminary investigations have also demonstrated ultrasound strain imaging can be used to monitor the ablated tissue. In summary, these catheter-based ultrasound devices allow for dynamic control of heating profiles along the length and angular expanse of the applicator during therapy delivery, are amenable to MR monitoring, and provide a minimally-invasive technique for true 3D control of hyperthermia and thermal ablation. (Support NIH R01CA122276, R01CA111981,& R41CA121740).