AbstractID: 9523 Title: MR Guided Focused Ultrasound (MRgFU) for Cance Therapy

Purpose: The purpose of this work was to commission and to evaluate the role of MR guided high intensity focused ultrasound (MRgHIFU) in cancer therapy in ex vivo and in vivo.

Method and Materials: An InSightec ExAblate 2000 HIFU system with a 1.5T GE MR scanner (MRgHIFU) is approved by FDA for the treatment of uterus fibroids clinically and being investigated in our department for treating bone metastases, prostate and breast cancers under local IRB approval. The phased array transducer is housed in a sealed bath and connected to a motion system. The focal region is cigar shaped, about 2mm in diameter and 10mm in focal length. Extensive experiments have been carried out on phantoms and excised tissues to determine optimal ultrasound parameters including the acoustic power output, frequency and exposure duration. We also performed in vivo studies on feasibility of enhancement of drug delivery for both chemotherapy and gene therapy using an animal model. Both MR T2-weight MR image and proton resonance frequency shift MR images were used for treatment planning and monitoring the effect of the treatment in real time.

Results: Phantom studies demonstrated that MRgHIFU could provide adequate temperature elevation for tissue ablation; acoustic power >10W leading to temperature elevation (ΔT) > 7 °C. At a lower acoustic power (5 W) we could keep ΔT < 4 °C, which is adequate for drug enhancement. The results were served for animal studies. Tissue damage was achieved at predetermined region in excised tissue through MR real-time guidance. Our preliminary results showed increased drug concentrations in MRgHIFU treated mice than the control group.

Conclusions: MRgHIFU may have a great potential as a safe, noninvasive treatment modality for cancer therapy including tumor ablation, enhancement of drug livery and boost treatment for hypoxic tumors in combination with radiotherapy.