AbstractID: 11144 Title: Magnetic Resonance Temperature Imaging Guided Laser-Induced Thermal Therapy with Multi-Walled Carbon Nanotubes

Purpose: Feasibility has been studied for combining Multi-Walled Carbon Nanotubes (MWNTs), as a near-infrared (NIR) laser absorber and heat generator, with Proton Resonance Frequency (PRF) based Magnetic Resonance Temperature Imaging (MRTI), to improve the safety and efficacy of laser-induced thermal therapy. **Method and Materials:** MWNTs-laser-induced therapy was evaluated using 3 tissue equivalent gel phantoms: alginate-only (sodium alginate 3g/L), MWNTs-instilled (0.5mg/ml) and MWNTs-implanted (sub-surface, simulating a sub-cutaneous tumor containing MWNTs). *In vivo* experiments used 4 RENCA kidney tumor bearing mice in their right flank, thermally treated using an external laser beam after direct MWNTs injection (100ug), and monitored by MRTI throughout the treatment. MRTI-guided laser-induced thermal therapy for phantom and *in vivo* experiments was performed using MR-compatible laser systems (fiber-optic and external laser beam) and a 7T MRI small animal scanner (Bruker Biospin). The 3-D MRTI *in vivo* protocol has a standard deviation of < 1°C, temporal resolution of 4.2s and a high spatial resolution of 0.25mm. **Results:** With minimum-invasive fiber-optic laser heating (ø 0.6mm, 1 min @ 0.1W), phantom results show that the MWNTs–instilled phantom heated preferentially (from 20°C to 47°C; Δt=+27°C), compared to the alginated-only phantom (from 20°C to 25°C; Δt=+5°C). With non-invasive laser heating (ø 10mm, 0.5 min @ 1.8W), the implanted region of the MWNTs-implanted phantom showed significantly elevated temperatures compared to the nearby alginate-only medium (Δt=+15°C). Implanted RENCA kidney flank tumors in mice injected with MWNTs were heated to 77°C (Δt=+51°C) after a single 30s 3W non-invasive laser irradiation compared to 44°C in the laser-only tumors (no MWNTs Δt=+18°C). In two weeks post-treatment study, all control tumors (no MWNT no laser) and laser-only tumors keep growing while MWNTs-tumors begin to shrink. **Conclusion:** This study indicates the significant improvement in small animal laser-induced thermal therapy and may be applicable for superficial tumors in humans.