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Presentation Abstract

Session:	4-5-Energy-Based Cancer Therapies: Mechanisms at Molecular, (Stem) Cell, and Systemic (Immune) Levels
Presentation:	In-vivo MR thermometry of HIFU induced temperature rise in porcine liver
Location:	302
Presentation Time:	Monday, Jul 07, 2014, 12:12 PM -12:30 PM

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Abstract: Introduction: High intensity focused ultrasound (HIFU) is a noninvasive medical procedure during which a large amount of energy is deposited in a short duration which causes sudden localized rise in tissue temperature, and ultimately, cell necrosis. Preclinical testing of HIFU systems is required to prevent collateral damage by the intense beam. In the preclinical characteriza-tion of thermal fields generated by HIFU, the temperature rise must be accurately measured. Magnetic resonance (MR) thermometry provides a method for non-invasive measurement of temperature during HIFU ablation procedure.
Methods: A set of in-vivo experiment on porcine livers (n = 3) was conducted in the MR bore to investigate the effect of HIFU transducer acoustic power on the maximum temperature rise and cavitation threshold. A HIFU transducer, having a focal length of 6.26 cm, outer diameter of 6.4 cm, inner diameter of 2.2 cm, and frequency of 1.1 MHz was used for the sonication process. Each porcine liver was sonicated in 3 different zones using acoustic powers of 10, 30 and 40 W for 30 sec sonication time. The sonication process was initiated at a time of 10 sec for all three powers. During the procedures, MR imaging was performed using a 3 Tesla whole body scanner. MRI-derived temperature rises were generated based on the proton resonance frequency (PRF) shift thermometry [1].
Results: The highest temperature maps for the powers of 30 W and 40 W are shown in Figs. 1A and 1B, respectively. The maximum temperature rise, which has been averaged over 3 trials, in-creased from 30.2 ± 8.6°C for 10 W, to 45.7± 5.4 °C for 30 W, and then to 56.6 ± 9.8 °C for 40 W. Some anomalies in the temperature trace, e.g., plateau without a distinct peak value between 30 sec and 40 sec, was observed at 40 W (Fig. 1C), indicating bubble cloud formation at the ini-tiation of cavitation.
Conclusion: Formation of bubbles during HIFU procedure at greater acoustic powers leads to distributed heating is one of the limiting factors to achieve higher focal temperature during the HIFU ablation procedure.

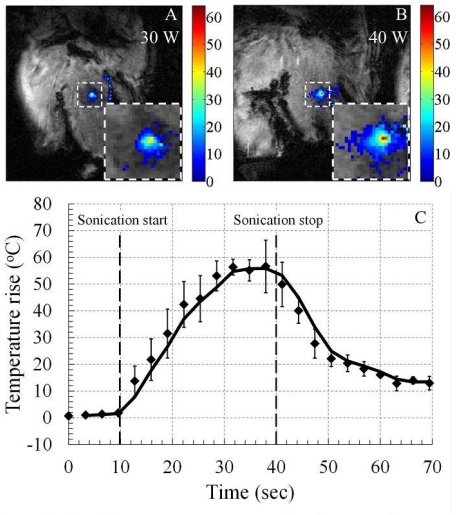

Figure 1. A) Highest temperature map for the acoustic power of 30 W; B) Highest temperature map for the acoustic power of 40 W; and C) HIFU induced temperature rise in porcine liver with sonication period of 30 sec using acoustic power of 40 W.

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