AbstractID: 11411 Title: Acoustic Droplet Vaporization for Enhancement of High Intensity Focused Ultrasound Thermal Ablation

Purpose:
Acoustic droplet vaporization (ADV) shows promise for the spatial control and acceleration of thermal lesion production. In this study, we investigated the hypothesis that ADV bubbles can substantially enhance HIFU ablation by increasing and controlling local energy absorption.

Method and Materials:
HIFU/ADV phantoms were made of polyacrylamide, egg white, degassed water and lipid-coated perfluoropentane droplets (1.8 μm mean dia.). These egg white-based phantoms (acoustic attenuation of 0.3 dB/cm at 1.44 MHz) were optically transparent, which allowed direct visualization of lesion formation during HIFU application. Phantoms were exposed in degassed water at 37°C to a focused ultrasound (1.44 MHz) with a focal intensity of 2000 W/cm^2. Lesion volumes were measured by fluid displacement or T2 weighted MR imaging.

Results:
For 2-s HIFU exposure on droplet-containing phantoms (n = 5), apparent opacity changes were observed consistently, while no lesions were found in phantoms without droplets (n = 8). It was noted that the volume of the lesion with 2-second HIFU exposure in droplet-containing phantoms was comparable to that made by 5-s exposure in the phantom without droplets. Lesion volumes (5-s exposure) measured by MR imaging were found to be 45.5±5.5 (n=8), 102.5±13.5 (n=5), and 288.0±50.1μL (n=8) in phantoms of 0, 10^4, 10^5 droplets/mL, respectively.

Conclusion:
The presence of ADV bubbles reduced the acoustic energy for comparably sized lesion and increasing the speed of HIFU lesion formation. Our findings may address the pre-focal heating problem in traditional HIFU ablation.