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ABSTRACT BOOK



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THE USE OF SHOCKWAVE EXPOSURES FOR ENHANCING VOLUMETRIC THERMAL ABLATION OF *EX VIVO* BOVINE LIVER ON A CLINICAL MRI-GUIDED HIFU SYSTEM

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OBJECTIVES

Clinical sonication protocols for volumetric lesion formation are based on heat deposition due to linear absorption of ultrasound waves in multiple foci and heat diffusion, which limits the accuracy of predicted lesion dimensions. This study characterizes the use of shockwave-assisted, ultrafast heating for predictable lesion formation.

METHODS

Volumetric thermal lesions (8-mm diameter) were generated in *ex vivo* bovine liver by concentric rings of focal target sites (c) using a clinical MR-HIFU system (Sonalleve V2, Profound Medical Inc). MRI was used for real-time guidance and post-sonication evaluation (a, b). Lesions obtained with the clinical protocol (CP) were compared to a shockwave protocol (SWP) with the same time-average but higher peak power. SWP sonications were designed based on ultrasound and thermal simulations (d). Lesions were analyzed grossly (e, f), by MRI (b), and histology for thermal denaturation (g, h).

RESULTS

CP lesions exhibited a diameter-to-length ratio of 1:2.5, with fuzzy margins (e, g). SWP lesions had narrow margins with shapes that correspond to predicted heat deposition patterns (f, h). Formation of volumetric SWP lesions required a denser distribution of focal sites (0.5 mm spacing *versus* 2 mm in CP); however, only a single 5-ms exposure was needed at each site (SWP: 5-ms pulse at 1 kW peak power followed by a 20-ms pause; CP: multiple 50 ms-pulses at 200 W).

CONCLUSIONS

A novel sonication protocol with shockwave heating allows delivery of precise thermal lesions with sharp borders between normal and thermally denatured tissue.

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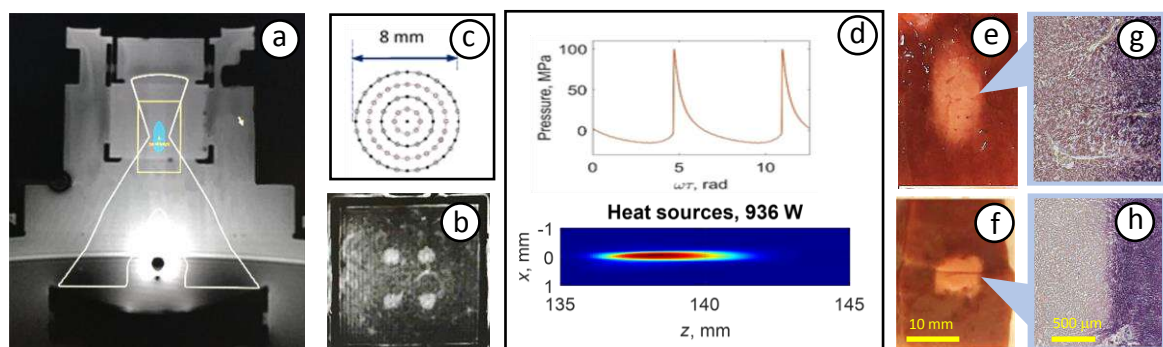


FIGURE CAPTION: a) MR image of the experiment set-up; b) transverse MR image of four SWP lesions; c) representative treatment foci pattern; d) focal pressure profile and calculated heat-source pattern in SWP; e) CP lesion; f) SWP lesion; g, h) NADH-diaphorase stained lesion borders showing viable tissue in purple and thermally denatured tissue in white.