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Therapeutic ultrasound induced cell death from a histological perspective

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High-power, short-exposure time, High Intensity Focused Ultrasound (HIFU) treatment protocols are under development that offer the potential to increase procedure throughput and optimize individual therapies. Histological examination and optical image analysis of tissues following dynamic HIFU exposure in ex vivo bovine liver have revealed that cells undergo a fundamentally different form of cell death. The rapid temperature rise due to the HIFU exposure leaves the cells structurally intact but no longer viable, similar to the cell "fixation" induced by snap-freezing. These results suggest that careful choice of both staining technique and metric for determining cell death are important in quantifying type and morphology of cell ablation, and more broadly, safety and efficacy of treatment. This finding is similar to those obtained and under discussion in the laser and RF ablation communities. Specifically, the NADH staining technique is superior to H&E for assessing cell viability, and an alternative measure of cell death may be preferable to the binary thermal dose threshold currently the standard for HIFU treatment. [Work supported by NIH.]