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Determination of porcine renal injury thresholds for therapeutic ultrasound

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The global prevalence of kidney stones is rising, and nearly half of patients that undergo surgical intervention experience complications associated with residual stone fragments that are not passed. Ultrasonic propulsion is a new therapeutic technique to non-invasively clear stones, which, in a clinical simulation, proved effective at repositioning kidney stones in pigs. The goal of this study was to establish a range of intensities under which stones could be repositioned without injury. A 2-MHz annular array was placed on the surface of in vivo porcine kidneys and focused in the proximal parenchyma. Individual exposures of 10-minute duration were comprised of duty cycles from 0-100% and spatial peak pulse-averaged intensities up to 26 kW/cm2 (derated through 1 cm of kidney tissue). The kidneys were histologically evaluated for injury by up to three independent experts blinded to the exposure conditions. The injury threshold for 100-µs ultrasound bursts repeated with a 3.3% duty cycle was 16.6kW/cm2 (derated). As the first generation prototype to reposition kidney stones utilized the same pulsing parameters with a maximum derated intensity of 2.4kW/cm2, the technique was shown to be safe. The injury threshold for exposures at 100% duty cycle was 0.5kW/cm2 (derated). This study showed that a range exists above diagnostic imaging levels and below tissue injury levels for which ultrasound therapies can be safely developed.

Biography

Julianna C Simon completed her PhD in 2013 from the University of Washington. She is currently working as a National Space Biomedical Research Institute. She is the First Award Postdoctoral Fellow at the University of Washington. She has co-authored 12 papers.

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