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**Frequency dependence of kidney injury induced by contrast-aided
diagnostic ultrasound**

Douglas Miller^a, Chunyan Dou^a and Roger Wiggins^b

^aUniversity of Michigan, Department of Radiology, Ann Arbor, MI 48109-0553, USA

^bUniversity of Michigan, Department of Internal Medicine (Nephrology), Ann Arbor, MI 48109, USA

Glomerular capillary hemorrhage (GCH) induced in rat kidneys by contrast aided diagnostic ultrasound was examined as a function of ultrasonic frequency. The right kidneys of anesthetized rats mounted in a water bath were exposed to image pulse sequences at 1 s intervals during intravenous infusion of diluted ultrasound contrast agent. Diagnostic ultrasound (DUS) scanners were utilized for exposure at 1.5, 2.5, 3.2, 5.0 and 7.4 MHz. A laboratory exposure system (LES) was used to simulate DUS exposure at 1.0, 1.5, 2.25, 3.5, 5.0 and 7.5 MHz at relatively high peak rarefactional pressure amplitudes (PRPAs). The exposed kidneys were removed and fixed for histology. GCH was measured by counting glomeruli with blood in the urinary (Bowman's) space on histological sections. The percentage of GCH at a fixed exposure frequency showed a rapid rise with PRPA above an apparent threshold. The threshold values were approximately proportional to the ultrasound frequency, with proportionality constants of 0.5 MPa/MHz for DUS and 0.6 MPa/MHz for LES exposures. The increasing thresholds with increasing frequency limited the GCH effect for contrast aided DUS, and no GCH was seen for DUS at 5.0 or 7.4 MHz for the highest available PRPAs.