A PRECLINICAL TRANSRECTAL SYSTEM FOR BOILING HISTOTRIPSY PROSTATE ABLATION

G.R. Schade¹, T.D. Khokhlova², C. Hunter³, W. Kreider³, P.B. Rosnitskiy⁴, P.V. Yuldashev⁴, O.A. Sapožnikov², V.A. Khokhlova³
¹Department of Urology, ²Department of Medicine, ³Center for Industrial and Medical Ultrasound, University of Washington, Seattle, USA
⁴Physics Faculty, M.V. Lomonosov Moscow State University, Moscow, Russia
e-mail: grschade@uw.edu; chunter6@uw.edu; wkreider@uw.edu; tdk7@uw.edu; olegs2@uw.edu; verak2@uw.edu

OBJECTIVES
Boiling histotripsy (BH) is a focused ultrasound (FUS) method that produces precise mechanical tissue ablation using milliseconds duration FUS pulses containing shocks. BH’s non-thermal mechanism and real-time treatment monitoring may improve on outcomes of contemporary thermal FUS prostate ablation.

METHODS
We built a preclinical transrectal BH system comprising a 2 MHz FUS transducer (5.0 x 3.5 cm, focus 4.0 cm) with inline B-mode imaging (Figure A), 1000 W amplifier, function generator and clinical imaging system. Acoustic output of the system was characterized in water. The ability to produce BH was assessed in polyacrylamide gel (PAC) and agar-embedded chicken breast (CB). BH thresholds were established for 1-10 ms pulses. BH lesions were generated in PAC (1-10 ms pulses) and CB (10 ms pulses) by administering 30 pulses at 1% duty factor.

RESULTS
The system outputs are presented in Figure B and produced peak+ and peak- pressures of 115 MPa and -21 MPa at 413 W acoustic power. Observed BH thresholds required shock amplitudes of 76, 76, 86, and 112 MPa for 10, 5, 2, and 1 ms pulses in PAC and 112 MPa for 10 ms pulses in CB. For all pulse durations, sharply demarcated lesions consistent with BH mechanical ablation were observed in both PAC (Figure C) and CB.

CONCLUSIONS
A custom-built transrectal BH system was acoustically characterized and demonstrated the ability to produce BH lesions ex vivo. Future experiments will evaluate ex vivo and in vivo prostate ablation.

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FIGURE: A) Transrectal FUS transducer, B) Plot of peak pressure values and shock amplitudes (SA), with inset showing waveforms at 130 W and 251 W, and C) appearance of lesions in PAC gel.