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In vitro evaluation of an oscillating 5-element dual-mode transducer

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Miniature dual-mode transducers can be used for minimally invasive treatment of deep-seated tumors. While in contact with the tissue, the transducer guides and monitors localized necrosis. Here, an oscillating 5-element piezo-composite transducer was characterized, and then evaluated in vitro using porcine liver. Each element was 3.0 x 3.8 mm^2 with a geometric cylindrical focus of 14 mm. The transmit frequency was determined by the maximal electro-acoustic efficiency, 65%, which was found at 5.6 MHz. The transmit-receive impulse response was 400 ns long at -6 dB, and the -6 dB fractional bandwidth, centered at 5.6 MHz, was 30%. Axial and lateral resolution measured with a 0.1 mm diameter wire was 0.5 mm and 2.0 mm, respectively. For therapy, all elements radiated simultaneously, and for imaging, independently. Treatment was performed at increments of 20° to form a composite volume of necrosis. At each angle, ultrasound was applied for 60 s at a transducer surface intensity of 15 W/cm^2. Pulse-echo data were recorded while the transducer oscillated over a 180° sector to form images before and after treatment at each angle. Gross examination of lesion size agreed well with echogenic region size in the images. [Supported by ANR and Inserm Post-doctoral Fellowship]