THE HEATING OF TISSUES BY A STRONGLY-FOCUSSED ULTRASOUND BEAM

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ABSTRACT

Experimental tests have been made of previous theoretical predictions (Swindell, 1985) that substantially non-linear propagation may occur in a focussed ultrasonic wave travelling through human soft tissues, with consequent enhancements (over linear conditions) in energy deposition rate and temperature rise around the focal region. Investigations were made at 0.56 and 1.74 MHz, using a 12.5 cm diameter plane transducer and biconcave Perspex lens that together resulted in a beam with approximately gaussian profile having width parameter of 4.03 cm at the lens surface, focal length of 13.6 cm and a pressure fwhm at the focus in water of 0.55 cm. Evidence for non-linearly induced heating enhancement in tissues was sought in a series of experiments in which thermocouple measurements of temperature at various points (including the beam focus) were made in ox and pig liver under conditions where ultrasonic emittance was held at constant time-average intensities whilst the peak amplitude was varied by changing the mark:space ratio in tone-burst conditions. At 1.74 MHz (but not at 0.56 MHz) evidence of non-linear behaviour was detectable in this way for acoustic pressure amplitudes above 0.6 MPa.

REFERENCE

W. Swindell, 'A theoretical study of nonlinear effects with focussed ultrasound in tissues: an "acoustic Bragg peak" ', Ultrasound in Med. Biol., 11, 121-130, (1985).