Potential Therapeutic Applications of Ultrasonically-Transitioned Perfluorocarbon Droplets for Therapy and Beam Aberration Corrections

Droplets for transitioning to bubbles larger than transpulmonary sizes were generated by mixing albumin (bovine with saline and a low boiling point liquid (dodecafluoropentane). The resulting emulsions contained droplets whose size ranges were determined by the mixing process. The lowest size range was on the order of a few microns diameter. The albumin, as a surface active agent, is assumed to build a shell around the droplets and prevents coalescence. Increases in temperature of the resting host fluid showed that droplets could be superheated well above their natural boiling point. The superheated state could be overcome by the application of ultrasonic pulses. Intravenously-administered droplets did traverse the lung in the rabbit.

The relatively large bubbles produced by these droplets show promise as direct therapeutic agents. Intra-arterial injections caused occlusions or no apparent effects in the leporine brain, depending on the concentration injected.

Acoustically-induced vaporization was observed in three frequency ranges: ~50 (kHz), 2 MHz (in the presence of contrast agent (CA)) and at 7 MHz (with and without CA). Conversions could be made at a mechanical index as low as 0.3 (p_- =0.8 MPa at 7.5 MHz). A diagnostic ultrasound system, using color Doppler mode as well as grayscale, was also able to phase transition the droplets in a flow tube.

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