A sampling of cavitation technologies in medicine

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Abstract

There is a relatively long history of using microbubbles to enhance diagnostic ultrasound images, and exciting new applications are being investigated for their therapeutic use. For this talk, we will explore three different applications of microbubbles from our lab.

(1) Real-time early detection of apoptosis for chemotherapy drug screening: Precision medicine in cancer requires a highly efficient approach to isolate cells for drug response and genetic analyses. Our innovative approach for cell sorting uses ultrasound and targeted microbubbles in order to sort specific cells with high sensitivity, specificity, and cell recovery rate. This novel technology will enable us to isolate rare cells from a very small number of cells from tumor biopsy samples and will be useful for drug screening and tumor heterogeneity research.

(2) Treatment of abscesses: Abscesses are infected walled-off collections of pus and bacteria. Current treatment is typically limited to antibiotics and catheter drainage. High Intensity Focused Ultrasound (HIFU) generates localized heating and cavitation, and represents a potential new noninvasive treatment modality. Our initial lab results show 2-log inactivation of Escherichia coli in suspension and from actual human pus.

(3) Sonochemical sample preparation in genomics and epigenetics: Sample preparation is an important step in many biological assays. Shearing DNA and chromatin is most often done with cavitation. However, most researchers rely on 'standard' ultrasound horn systems that are non-optimal, resulting in time-consuming, error- and degradation-prone processes. The resulting assays can be difficult to interpret, even if the assay itself has been optimized. We have developed a method for sample preparation in 96 well microplates that is fast and convenient, and may reduce errors and sample degradation. Clinically, such a system may be useful for biomarker detection or drug efficacy testing.

Biography

Dr. Matula received his Ph.D. in Physics in 1992. His early work involved sonoluminescence, the emission of light from a violently collapsing bubble, for which he was awarded the DOE Young Scientist and Engineer Award, and the Presidential Early Career Award (PECASE). During that period he flew his experimental system aboard NASA's parabolic research aircraft, the "vomit comet." He spent the next phase of his career learning about microbubbles used in medicine, and developing techniques to probe the viscoelastic characteristics of their shell. Currently he runs the Center for Industrial and Medical Ultrasound (CIMU), and the Center for ultrasound-based molecular imaging and therapy (uWAMIT), at the Univ. of Washington, Seattle.