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Light plus Sound: Photoacoustic Imaging and Treatment

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Photoacoustic imaging (PAI), also referred to as optoacoustic imaging, is an emerging biomedical imaging technology that is noninvasive, nonionizing, with high sensitivity, satisfactory imaging depth and good temporal and spatial resolution. Like conventional optical imaging, PAI presents the optical contrast which is highly sensitive to molecular conformation and biochemical contents of tissues and can aid in describing tissue metabolic and hemodynamic changes. Unlike conventional optical imaging, the spatial resolution of PAI is not limited by the strong light diffusion but instead determined by the measurement of light-generated ultrasonic signals. As a result, the resolution of PAI is parallel to high-frequency ultrasonography. At the University of Michigan School of Medicine our research has been focused on clinical applications of PAI, including arthritis, cancer, liver conditions, Crohns disease, and eye diseases. In this talk, I will introduce some of our recently development of PAI technologies, including 1) development of point-of-care PAI system for human inflammatory arthritis, and 2) development of quantitative PAI for evaluating histological micro features and microenvironment of cancer. I will also present our recent development of a photoacoustic based anti-vascular technology named photo-mediated ultrasound therapy (PUT). Using a combination of a low intensity laser concurrently with ultrasound, PUT can noninvasively remove micro vessels without damaging surrounding biological tissue, and shows potential to the treatment of a variety of diseases associated with neoangiogenesis, such as age-related macular degeneration and diabetic retinopathy, as well as port-wine stain and cancer.