

Novel, Noninvasive Techniques for Diagnostics and Therapy: Animal and Clinical Studies

Rinat O. Esenaliev

Laboratory for Optical Sensing and Monitoring, Center for Biomedical Engineering, Department of Neuroscience and Cell Biology, Department of Anesthesiology, and UTMB Comprehensive Cancer Center
The University of Texas Medical Branch,
Galveston, Texas, USA 77555-1156
riesenal@utmb.edu

Extended Abstract

We have developed novel, noninvasive optical and ultrasound techniques for diagnostics and therapy. Our group has pioneered one of these techniques, optoacoustics for imaging, monitoring, and sensing. Optoacoustics combines optical contrast with ultrasound resolution, if short optical pulses are used to generate optoacoustic waves in tissue and wide-band ultrasound transducers are used for optoacoustic wave detection.

This technique can be used for noninvasive detection and characterization of intracranial hematomas, monitoring of multiple physiological parameters such as central venous oxygenation, cerebral venous oxygenation, and total hemoglobin concentration. Invasive measurements of these parameters are routinely used in the care of large populations of patients including patients with traumatic brain injury, critically ill patients, patients with circulatory shock, anemic patients, surgical patients.

We developed and built optoacoustic systems for monitoring and imaging and tested them in small and large animals as well as in patients and healthy volunteers. The obtained results demonstrate high accuracy and specificity of measurements resulted from high-resolution probing of tissues of interest (Petrova et al., 2009; Esenaliev, 2011; Petrov et al., 2012; Petrov et al., 2012; Petrov et al., 2014).

A novel, high-resolution (30 microns) ultrasound imaging system Vevo 2100 that was acquired for UTMB researchers can be used in many cardiovascular, cancer, neuroscience, and developmental biology projects. We will provide an overview of the major results obtained with this high-resolution ultrasound system.

Our noninvasive therapeutic applications are focused on drug and gene delivery or on direct thermal or mechanical damage to tumors using ultrasound or light and based on interaction of nanoparticles with optical or ultrasound radiation (Esenaliev, 2000; Chumakova et al., 2008; Figueiredo, Esenaliev, 2012)

We will report results obtained in animal and clinical studies with these and other high-resolution techniques developed by our group.

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