PHOTOACOUSTIC AND ULTRASOUND MULTI-MODALITY MOLECULAR IMAGING: OPPORTUNITIES AND CHALLENGES

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Among various molecular imaging modalities, ultrasonic imaging and photoacoustic imaging provide unique advantages and also face specific challenges. Ultrasonic molecular imaging, on one hand, is based on mechanical properties of the image object and many unique applications have been developed. With the aid of superior spatial resolution, high frequency ultrasound imaging has also evolved from clinical anatomical imaging to probing of molecular processes on small animals for pre-clinical research. Photoacoustic imaging, on the other hand, combines advantages of both optics and acoustics. Research developments in imaging physics and instrumentation have also found promising biomedical applications. In addition, microbubbles typically used in ultrasonic imaging as the contrast agent present unique mechanical properties and the associated acoustic cavitation has been exploited for therapeutic purposes. Similarly, gold nanoparticles are found to be an ideal contrast agent for photoacoustic imaging for its bioconjugation capabilities and presumed safety. The efficient light absorption of gold nanoparticles and abilities to tune their optical properties have also led to new photothermal therapy techniques. In this talk, physics, instrumentation and applications of ultrasonic and photoacoustic imaging will be reviewed. New development in combined diagnosis with therapy for both modalities will also be introduced, with a discussion on possible synergy and the technical difficulties that each modality faces, before critical clinical impact can be made.