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Ultrasound for preclinical research: "Shear wave imaging and photoacoustic imaging of small animals and 3D cell culture systems"

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Abstract:
Ultrasound has been widely used for preclinical research on small animals. Another emerging area of preclinical research is based on the use of 3D cell culture systems. To fully exploit the value of preclinical research on small animals and 3D cell culture systems, new imaging and therapeutic technologies are needed. To this end, recent works on preclinical ultrasound in two particular areas will be covered in this lecture: acoustics based theranostic technologies and shear wave elasticity imaging. The acoustics based theranostic technologies are regarding the combination of ultrasound and photoacoustic/photothermal effects for synergistic delivery of gold nanoparticles using multifunctional microbubbles/nanodroplets for enhanced plasmonic photothermal therapy. In the second part of the lecture, we will present the applications of shear wave elasticity imaging to both small animals and 3D cell culture systems. In both cases, conventional shear wave imaging methods do not provide adequate accuracy and resolution, thus new approaches are needed. 3D cell culture systems have been used as an effective tool for preclinical research as they represent a more realistic model for cells compared to conventional 2D systems. Specifically, spatial dynamics of extracellular matrix provides a wealth of information concerning the collective activities and intercellular crosstalk of adhering cells. Shear wave elasticity imaging methods have been developed for 3D cell culture systems and research progress will be presented in this lecture. Finally, we will describe latest results on a microfluidic platform for a 3D microtumor culture system, as well as how photoacoustic molecular imaging and shear wave elasticity imaging can be applied to study mechanobiology on this platform. It will be clear to the audience that the role of ultrasound in preclinical research is significant and indispensible.

Short Bio:

Pai-Chi Li received the B.S. degree in electrical engineering from National Taiwan University in 1987, and the M.S. and Ph.D. degrees from the University of Michigan, Ann Arbor in 1990 and 1994, respectively, both in electrical engineering: systems. He joined Acuson Corporation, Mountain View, CA, as a member of the Technical Staff in June 1994. His work in Acuson was primarily in the areas of medical ultrasonic imaging system design for both cardiology and general imaging applications. In August 1997, he went back to the Department of Electrical Engineering at National Taiwan University, where he is currently Associate Dean of College of Electrical Engineering and Computer Science, and Distinguished Professor of Department of Electrical Engineering and Institute of Biomedical Electronics and Bioinformatics. He is also the TBF Chair in Biotechnology. He served as Founding Director of Institute of Biomedical Electronics and Bioinformatics in 2006-2009 and National Taiwan University Yong-Lin Biomedical Engineering Center in 2009-2011. His current research interests include biomedical ultrasound and medical devices. Dr. Li is IEEE Fellow, IAMBE Fellow, AIUM Fellow and SPIE Fellow. He was also Editor-in-Chief of Journal of Medical and Biological Engineering, and has been Associate Editor of Ultrasound in Medicine and Biology, Associate Editor of IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, and on the Editorial Board of Ultrasonic Imaging and Photoacoustics. He has won numerous awards including Distinguished Research Award, the Dr. Wu Dayou Research Award and Distinguished Industrial Collaboration Award.