

Optical Diagnostic and Biophotonic Methods from Bench to Bedside

The sixth Inter-Institute Workshop on Optical Imaging from Bench to Bedside was held at the National Institutes of Health (NIH) in Bethesda, Maryland, in October 2009. The broad impact of biophotonics on biomedical research was exemplified by the generous support that was provided by several diverse institutes and centers within NIH. These included the National Heart, Lung, and Blood Institute (NHLBI), National Institute of Biomedical Imaging and Bioengineering (NIBIB), National Eye Institute (NEI), National Institute of Child Health and Human Development, National Institute of Neurological Disorders and Stroke, and the Office of Dietary Supplements. More than 500 people attended the workshop including university researchers, students, government scientists, and industrial entrepreneurs and scientists from the United States and abroad. Scientific presentations by Dr. Robert Balaban (scientific director of the NHLBI), Dr. Richard Leapman (scientific director of NIBIB), and Dr. Sheldon Miller (scientific director of NEI) showed the enthusiasm of NIH's intramural research programs for biophotonics and biomedical optics.

Since the previous workshop in 2006 there has been further development of sophisticated imaging technologies and continued clinical translation of biophotonics in areas such as cardiovascular disease, ophthalmology, neuroscience, and cancer. Biophotonics is at the forefront of nanoimaging with major advances in methods such as stimulated emission depletion microscopy, photoactivated localization microscopy, and stochastic optical reconstruction microscopy. These approaches overcome the traditional diffraction-limit barrier of light microscopy and bring nanoscopic imaging to biomedical researchers around the world. Similarly, several state-of-the-art optical imaging technologies are now available as prototype medical devices based on methods such as optical coherence tomography (OCT), confocal/nonlinear microscopy, photoacoustic tomography, fluorescence spectroscopy, Raman/vibrational spectroscopy, and diffuse optical imaging. These technologies continue to undergo translation from bench to the bedside in a broad variety of studies spanning from endoscopic imaging to functional brain mapping, and many are progressing towards large-scale, multicenter clinical trials.

The workshop was organized over two full days into 8 sessions with 33 presentations, 119 posters, and 3 panel discussions. The oral presentations were focused primarily on the imaged organ site rather than the imaging technique, in order to advance new bench-to-bedside concepts and identify barriers to clinical translation. The areas of organ/tissue emphasis included eye, brain, breast, and vascular imaging. Recent advances in three rapidly emerging technical areas were also presented that covered molecular probes

and targets, the translation from microscopes to endoscopes, and stem-cell imaging. All sessions included presentations that employed biophotonics technologies ranging from microscopy to macroscopic *in vivo* imaging in human subjects and preclinical models. Three provocative panel discussions focused on cost effectiveness, barriers to translation, and NIH funding opportunities. A general consensus emerged from the panels and discussions throughout the workshop that many optical technologies can now provide equivalent or superior performance to clinical standards of care, often at reduced cost. Various strategies were discussed that would reduce barriers to clinical translation and improve access to new optical technologies. Substantial discussion was devoted to the need to support commercialization and standardization of early-stage prototypes, facilitate investigator-initiated, hypothesis-based, multicenter trials, and develop quantitative measures of outcome/efficacy.

As another established tradition, the workshop honored Professor Tayyabba Hasan of the Wellman Center at Harvard Medical School/Massachusetts General Hospital for her extraordinary pioneering contributions to multidisciplinary research and teaching in biomedical optics. Professor Hasan joined previous awardees Professors Britton Chance, John Parrish, and Brian Wilson as the fourth NIH Inter-Institute Bench to Bedside Pioneer for her seminal work in photomedicine and photodynamic therapy (PDT). Professor Hasan's award citation noted her essential role in the highly successful bench-to-bedside translation of PDT in ophthalmology, and her creative contributions to the development of photoimmunotherapies for cancer.

The papers submitted to this special section reflect the composition of the workshop by presenting novel technologies for imaging disease, many overcoming significant barriers to clinical translation. Manuscripts include ophthalmic imaging with OCT, breast imaging with diffuse multispectral tomography, skin imaging using micro- and macroscopic technologies, functional and noninvasive optical brain imaging, vascular imaging, as well as novel microscopy modalities and 3-D visualization (e.g. see D. Gareau, et. al). We hope you enjoy reading and imaging, and plan to attend the next workshop in Fall 2011.

Amir Gandjbakhche
National Institutes of Health

Bruce Tromberg
University of California, Irvine

Special Section Guest Editors