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Shine a Light on Cancer: Bioimaging and Nanomedicine

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Two fundamental and unsolved problems facing bioimaging and nanomedicine are nonspecific uptake of intravenously administered diagnostic and/or therapeutic agents by normal tissues and organs, and incomplete elimination of unbound targeted agents from the body. To solve these problems, we have synthesized a series of indocyanine near-infrared (NIR) fluorophores that varied systematically in net charge, conformational shape, hydrophilicity/lipophilicity, and charge distribution. Using 3D molecular modeling and optical fluorescence imaging, we have defined the relationship among the key independent variables that dictate biodistribution and tissue-specific targeting such as lung and sentinel lymph nodes (*Nat Biotechnol.* 2010), human prostate cancers (*Nat Nanotechnol.* 2010), and human melanomas (*Nat Biotechnol.* 2013). Recently, we have developed new pharmacophore design strategy “structure-inherent targeting,” where tissue- and/or organ-specific targeting is engineered directly into the non-resonant structure of a NIR fluorophore, thus creating the most compact possible optical contrast agent for bioimaging and nanomedicine (*Angew Chem.* 2015, *Nat Med.* 2015). The biodistribution and targeting of these compounds vary with dependence on their unique physicochemical descriptors and cellular receptors, which permit 1) selective binding to the target tissue/organ, 2) visualization of the target specifically and selectively, and 3) provide curing options such as image-guided surgery or photo dynamic therapy. Our study solves two fundamental problems associated with fluorescence image-guided surgery and lays the foundation for additional targeted agents with optimal optical and *in vivo* performance.

KEY WORDS: Nanotechnology; Optical imaging; Diagnostic imaging; Tumor targeting; Near-infrared fluorophore; Biodistribution; Clearance; Image-guided surgery



Biography: Dr. Hak Soo Choi is an Associate Professor of Radiology at Harvard Medical School and faculty of Dana Farber/Harvard Cancer Center, and the Director of Bioengineering and Nanomedicine Program at Massachusetts General Hospital (MGH). Dr. Choi is a graduate of School of Materials Science from JAIST in 2004, and experienced Gene and Drug Delivery Systems as a postdoc. He extended his research into Molecular Cancer Imaging at Harvard Medical School and Beth Israel Deaconess Medical Center in Boston. Since 2008, his laboratory focuses on the development of novel contrast agents for tissue- and organ-specific targeting and diagnosis, and recently joined the Gordon Center for Medical Imaging of Massachusetts General Hospital. Of particular interest is tissue-specific fluorophores, which can be used for targeting and imaging of human diseases by specifically visualizing target tissue with high optical properties and by avoiding nonspecific uptake in normal background tissues.