Hak Soo Choi, Ph.D.

Massachusetts General Hospital
149 13th Street, Rm 5420
Boston, MA 02129
Office: 617-726-5784; Fax: 617-643-2604
hchoi12@mgh.harvard.edu
https://sites.google.com/view/benmd

Professor of Radiology
Division of Nuclear Medicine
Harvard Medical School

Director, Bioengineering & Nanomedicine
Gordon Center for Medical Imaging
Massachusetts General Hospital

Shine a Light on Cancer: Bioengineering and Nanomedicine

Hak Soo Choi, Ph.D.

Professor, Department of Radiology, Harvard Medical School
Director, Bioengineering and Nanomedicine Program, Massachusetts General Hospital
Faculty, Cancer Research Institute, Dana-Farber/Harvard Cancer Center

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 contrast agents 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 a new pharmacophore design strategy "structure-inherent targeting," where tissue-specific targeting is engineered directly into the non-resonant structure of a near-infrared fluorophore, thus creating the most compact possible optical contrast agent for bioimaging and nanomedicine (*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 cancer specifically and selectively, and 3) provide curing options such as image-guided surgery or photon-induced therapy. Our study solves two fundamental problems associated with bioimaging and nanomedicine 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