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Bioimaging and Nanomedicine *via* Invisible Near-Infrared Fluorescence

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My research focuses on the development of novel tissue- and organ-specific contrast agents for diagnosis, staging, and treatment of human diseases. Of particular interest is tumor-targeted fluorophores, which can be used for image-guided surgery by specifically visualizing target tissue with high optical properties and by avoiding nonspecific uptake in normal background tissues. During the past decade, we have been systematically probing the relationship among the hydrodynamic diameter, shape, charge, and hydrophobicity of nanoparticles and small molecule contrast agents on *in vivo* biodistribution and clearance (*Nature Biotech.* 2007, *Nano Lett.* 2009, *Angew Chem Int Ed.* 2011).

Using invisible near-infrared (NIR) fluorescence and 3D molecular modeling, we have defined the key independent variables that dictate biodistribution and tissue-specific targeting such as lung and sentinel lymph nodes (*Nature Biotech.* 2010), human prostate cancers (*Nature Nanotech.* 2010), and human melanomas (*Nature Biotech.* 2013). Another project we have been working on is targeting of endocrine glands and their tumors. Currently we have achieved specific targeting on the thyroid/parathyroid glands (*Nature Medicine*, 2015), pancreas, thymus, pituitary gland, and adrenal glands. We have also developed other tissue-specific targeted fluorophores for lymph nodes, bone and cartilage, kidneys, liver, lungs, spleen, salivary glands, brown fat, seminal vesicle, and prostate. Regenerative medicine with tissue-engineered scaffolds is another area of interest, and we have developed biodegradable NIR scaffolds and cellular trafficking systems for longitudinal monitoring of tissue regeneration. Using dual-channel intraoperative imaging systems, we are currently trying to target cancerous tissue/vasculature/nerve (tumors), cardiovascular diseases, and bone/cartilage/inflammation (rheumatoid arthritis) simultaneously with different colors, which lay the foundation for clinical translation to image-guided surgery.

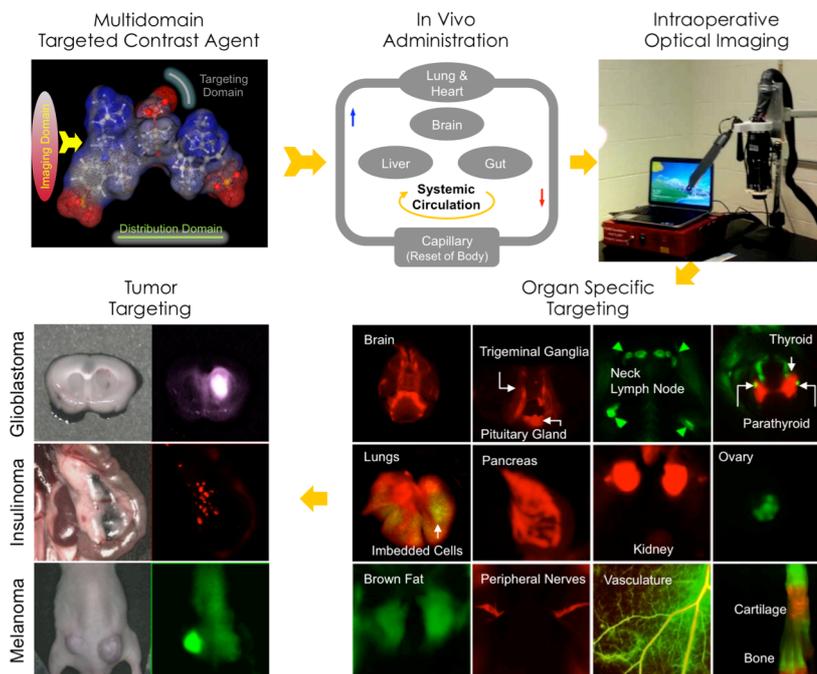


Figure 1. Development of tissue- and organ-specific contrast agents for targeting, bioimaging and nanomedicine.