SL20 Multiplexed Molecular Imaging; A New Strategy for Cancer Diagnosis and Therapy

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The goal of targeted therapies is to specifically destroy tumors while leaving normal tissue intact. However, the ability to target cancers with single targeting ligands is still limited. A method for better targeting might not only lead to improved cancer therapy but could also be used diagnostically. Currently available imaging contrast agents are monotonic in their ability to report information i.e. they produce images in gray scale such as CT, MRI, SPECT and PET. Therefore, conventional imaging methods are mostly uni-parametric. More specific and precise data about the nature of a tumor could be derived from multi-parametric data acquisitions. We are currently developing imaging agents and techniques with multi-parametric capabilities, so called "multiplexed (molecular) imaging". using one of three strategies: multi-modalities, multi-color agents, and activatable "smart" agents. Multi-color imaging agents involve simultaneous or separate injections of multiple agents either singly or as a "cocktail", which can produce different signal emissions depending on the nature of the target tissue. Such imaging can be decoded with spectral-resolved or energy-resolved imaging technology especially using the optical imaging where background signals from auto-fluorescence or unbound target reagents can also be greatly reduced. Activatable "smart" agents are designed to emit signals only within cancer cells/tissues under certain conditions such as low pH, oxidation, or in the presence of specific enzymes, by conformational changes of agents due to binding to a target molecule, etc.. Multi-modal imaging strategies employ more than one imaging modality to characterize a target (e.g. PET and CT). Furthermore, multi-modal agents, which are based on a single agent with two or more imaging signatures (such as optical and MRI or radionuclide and optical), have also been developed. Each of these strategies is independent, therefore, the combined use of two or more strategies has the potential to obtain additional parameters from an image.

In this lecture, I will discuss recent developments in our program in the field of cancer molecular imaging methods using agents based on these three strategies and then present practical applications of these new targeting imaging agents for cancer. Finally, I will also discuss the pathways to clinical translation of these new targeted-imaging technologies.