Molecular Imaging as a Cancer Biomarker: Imaging to Guide Targeted Cancer Therapy

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Abstract: The ability to assay tumor biologic features and the impact of drugs on tumor biology is fundamental to drug development. Advances in our ability to measure genomics, gene expression, protein expression, and cellular biology have led to a host of new targets for anticancer drug therapy. In translating new drugs into clinical trials and clinical practice, these same assays serve to identify patients most likely to benefit from specific anticancer treatments. As cancer therapy becomes more individualized and targeted, there is an increasing need to characterize tumors and identify therapeutic targets to select therapy most likely to be successful in treating the individual patient’s cancer. Thus far assays to identify cancer therapeutic targets or anticancer drug pharmacodynamics have been based upon in vitro assay of tissue or blood samples. Advances in functional and molecular imaging have led to the ability to perform quantitative non-invasive molecular assays. Imaging has traditionally relied on structural and anatomic features to detect cancer and determine its extent. This traditional form of imaging, often termed anatomic imaging, has made an important contribution to cancer care and is widely used in the detection and staging of cancer patients using methods such x-ray mammography and computed tomography (CT). More recently, imaging has expanded to include the ability to image regional biochemistry and molecular biology, often termed molecular imaging. Molecular imaging can be considered an in vivo assay technique, capable of measuring regional tumor biology without perturbing it. This makes molecular imaging a unique tool for cancer drug development, complementary to traditional assay methods, and a potentially powerful method for guiding targeted therapy in clinical trials and clinical practice.

This talk will review current and future applications of molecular imaging as a biomarker for cancer therapy, including the use of imaging to (1) identify patients whose tumors express a specific therapeutic target; (2) determine whether the drug reaches the target; (3) identify an early, pharmacodynamic response to treatment; and (4) relate response to patient survival. The talk will review basic concepts important in the application of molecular imaging to cancer drug therapy, discuss specific examples of studies in humans, and highlight future directions, including ongoing multi-center clinical trials using molecular imaging as a cancer biomarker.