# *In vivo* Molecular Imaging of Cancer

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*in vivo* imaging such as MRI, positron emission tomography (PET) has been playing an important role in diagnosing diseases and monitoring treatment for decades. Recently, *in vivo* imaging is widening its field through revealing molecular event in cells and tissues. Molecular imaging is used for earlier detection, characterization of disease and an earlier assessment of treatment efficacy through imaging molecular/cellular events in living organisms.

PET has been used mostly for oncologic diagnosis such as differential diagnosis, staging, monitoring therapy, and detecting recurrence of cancer. F-18 fluoro-2-deoxyglucose (FDG) is a radiotracer in staging and restaging of cancer. The role of PET in monitoring therapeutic response is being actively investigated, and early results are promising. One of the major advantages of using PET is ability of tracing any molecules *in vivo*. New radiotracers are investigated such as F-18 FLT for tumor cell proliferation, F-18 FMISO for hypoxia, C-11 methionine for the brain lesions and C-11 acetate for hepatocellular carcinoma.

Molecular imaging is useful not only for clinical studies but also for developing new drugs and new treatment modalities such as gene or stem cell therapy. Pre-clinical molecular imaging using animals such as mice shows biodistribution, pharmacokinetics, mechanism of action, and efficacy *in vivo*. *in vivo* imaging not only reduces the number of animals for the experiment, but also increases the confidence of results by removing the factor of individual variability.

Nanoparticles are able to carry fluorescent dye, radioisotope, drugs, genes, and targeting biomarkers. These multifunction nanoparticles can be used for diagnostic in vitro and *in vivo* and therapeutic purpose as well. One of the examples is molecular imaging targeting biomarkers. If we combine nanotechnology and high throughput proteomics searching for individual biomarkers, personalized targeting therapy can be possible after validating the targeting efficiency using multimodal multiplexing *in vivo* imaging.