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Multiphoton and photothermal imaging of molecular events in cancer[1]

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Optical techniques are attractive for monitoring disease processes in living tissues because they are relatively cheap, non-invasive and provide a wealth of functional information. Multiphoton microscopy (MPM) and Optical Coherence Tomography (OCT) are two types of three-dimensional optical imaging modalities that have demonstrated great utility in pre-clinical models of disease. These techniques are particularly useful for identifying metabolic and molecular biomarkers in cancer. These biomarkers can be used to identify the mechanisms of tumor growth, and to predict the response of a particular tumor to treatment. Specifically, MPM of the co-enzymes NADH and FAD was used to quantify metabolic changes associated with developing cancers in vivo. This imaging technique exploits intrinsic sources of tissue contrast and thus does not require contrast agents. Ongoing work combines this metabolic imaging technique with vascular imaging to provide a comprehensive picture of oxygen supply and demand with tumor therapy. Molecular signaling represents a third critical component in tumor physiology. To this end we have recently developed photothermal OCT, which combines coherent detection with laser-heated gold nanoparticles to achieve high-resolution molecular contrast at deeper depths than MPM. This multi-functional imaging platform will provide unprecedented insight into oxygen supply and demand, and molecular signaling in response to tumor growth and targeted cancer therapies in pre-clinical models.

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