

Purpose: Employ volumetric photoacoustic computed tomography (PA-CT) imaging to monitor key indices of tumor biology in tumor bearing mice without the use of exogenous contrast. In this study we describe the scanning system and its use in tracking in vivo tumor vasculature and tumor volume, through tumor growth and following treatment by anti-angiogenic therapy, in both control and treated animals.

Methods: A PA-CT scanner, specifically designed for mouse imaging, employs a sparse array of 128 discrete transducer elements (3mm in diameter, 5MHz center frequency) arranged on a hemispherical surface, a tunable NIR pulsed laser (680-950nm), and a digital acquisition system with 128 channels. The tissue being imaged is illuminated directly by pulses of laser light and the resulting photoacoustic signals are recorded. The photoacoustic data is reconstructed using a modified 3-D Radon transform to produce a spherical volume 25mm in diameter. EGFR+ MCF-7 breast cancer cells were injected into two groups (control and treatment) of mice (n=6). The tumors were allowed to grow to approx. 10mm in size at which point the treatment group was injected with a single dose of Avastin (40mg/kg). The mice were scanned at 17, 27, and 34 days post-implantation.

Results: The tumor vascularity was quantified by measurement of hemoglobin (Hb) content in the tumor. The Avastin treated mice showed an average decrease of 65% in hemoglobin content following treatment while the control group had an average increase in tumor Hb content of 33%.

Conclusions: The strong absorption of NIR light by oxy-hemoglobin and deoxy-hemoglobin provides a useful contrast mechanism for photoacoustic imaging without the use of exogenous contrast agents. Photoacoustic imaging is well suited to in vivo studies of cancer therapies where the tumor vasculature is a marker of the efficacy of the therapy or intervention.

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