In Vivo Imaging of Hypoxia: Hemodynamic Model of Tumor Oxygenation

Stantz KM, Cao N, Shaffer M, Lee Chung-Wein, Liu B, Miller K, Ko A

1 Medical Physics, School of Health Sciences, Purdue University

This page contains a presentation slide with the title "In Vivo Imaging of Hypoxia: Hemodynamic Model of Tumor Oxygenation". The slide includes text and diagrams related to the topic of hypoxia, tumor oxygenation, and biophysical modeling. The content is focused on the development and validation of a multivariate in vivo hemodynamic model of tissue oxygenation (MiHMO₂) based on 3D photoacoustic imaging. The model integrates physiological and microenvironmental factors to provide a comprehensive measure of tissue oxygen concentration. The presentation also discusses the objectives related to etiology, biophysical modeling, and radiation therapy of hypoxia.
**Photoacoustic Imaging**

**Experimental Protocol**

**Photoacoustic Computed Tomography**

**Morphology**

**CROP IMAGES**

**Parametric Images**

**MCF<sup>12</sup> and MCF<sup>7</sup> Breast Tumors**

- MCF<sup>12</sup>
- MCF<sup>7</sup>

**Methodology**

A 1.0 mm<sup>3</sup> ROI was placed at position along a straight line through the center of the tumor, which approximates the actual position of the OxyLife probe (red).
Comparison Between OxyLite™ Probe and Tumor Hemodynamics

Perfusion and fractional plasma volume measurements

**DYNAMIC CONTRAST-ENHANCED PCT (DCE-PCT)**

**DCE-PCT**

**Dynamic Contrast-Enhanced Imaging**

Measurements of Vascular Physiology

Using equation (i), the value for the oxygen partial pressure (pO2) was calculated based on the hemodynamic parameters measured using PCT-6 and DCE-CT. These values were compared to values measured using the OxyLite™ probe.
Dynamic Contrast-Enhanced PCT
Using PCT to Measure Vascular Physiology

Oxygen Production as Measured by PCT-S

IMOG ‘plus’ Radiation Therapy
Tumor Growth Curves

Summary

- The is the first set of experiments comparing intra-tumor measurements of SaO2 and $C_{\text{inh}}$ using PCT-S to pO2 values.
- Developed and tested a biophysical model to determine local pO2 measurements and parameters contributing to hypoxia.
- Demonstrated a new medical device that can modulate the tumor oxygen microenvironment to improve RT

Acknowledgements

Purdue University
School of Health Sciences
Ning Cao
Michael Shaffer
Bo Qin
Chung-Wein Lee
Akshay P

Indiana University
School of Medicine
Radiation Oncology
Marc Mendona, Ph.D.
Song-Chu Ko, M.D.
Minsong Cao, Ph.D.

Electrical Engineering/Birck Nanotechnology Center
Baba Ziaie
Seung Hyun Song
Teimour Maleki

This research is supported in part by NIH/NIHRR#R44CA130811-05 "Photoacoustic CT for Preclinical Molecular Imaging"; IBIS, Indiana Institute of Biomedical Imaging Sciences; and the School of Health Sciences.