Hypoxia
part of the Molecular Imaging Resident Training Series

August 14, 2012 | 2:00pm ET | Register

Brief description:
Hypoxia, a condition of insufficient O$_2$ to support metabolism, occurs when the vascular supply is interrupted, as in stroke or myocardial infarction, or when a tumor outgrows its vascular supply. When otherwise healthy tissues lose their O$_2$ supply acutely the cells usually die by necrosis; when cells gradually become hypoxic they adapt by up-regulating the production of numerous proteins that promote their survival. These proteins slow the rate of growth, switch the mitochondria to glycolysis, stimulate growth of new vasculature, inhibit apoptosis and promote metastatic spread. The consequence is that patients with hypoxic tumors invariably experience poor outcome to treatment.

This has led to develop assays for hypoxia in patients, including regional measurements from O$_2$ electrodes placed under CT guidance, several nuclear medicine approaches with imaging agents that accumulate with an inverse relationship to O$_2$, MRI methods that measure either oxygenation directly or lactate production as a consequence of hypoxia, and optical methods with NIR and bioluminescence. The advantages and disadvantages of these approaches will be described, along with the strategies for validating different methods. Ultimately the proof of value is in the clinical performance to predict outcome, select an appropriate cohort of patients to benefit from a hypoxia-directed treatment or to plan radiation fields that result in better local control. Hypoxia imaging in support of molecular medicine has become an important success story over the last decade and provides a model and some important lessons for development of new molecular imaging probes or techniques.

Four learning objectives:

1. Describe the biological consequences of hypoxia.
2. Understand the advantages and disadvantages of alternative methods for assessing regional hypoxia.
3. Describe the procedure for radiosynthesis, quality control and radiation dosimetry of FMISO and the imaging protocol and analysis.
4. Appreciate the treatment implications of regional hypoxia. How should patient management be altered if the hypoxia scan is positive?

About the Presenter:

Kenneth Krohn is Professor of Radiology, Radiation Oncology and Chemistry at the University of Washington. Dr. Krohn is a chemist who has led a NCI program on Molecular Imaging of Cancer and Its Response to Therapy since 1986. The program develops new PET and MRI procedures with to characterize (rather than detect) tumors in ways that have implications for therapy. His laboratory pioneered development of PET agents for imaging cellular proliferation, regional hypoxia, acquired multi-drug resistance and hormone receptors. His program critically evaluates these imaging strategies to test whether they can be used to select appropriate patient cohorts for targeted therapy.