

AbstractID: 4448 Title: Positron Emission Tomography for Oncologic Imaging and Treatment

Purpose: Positron Emission Tomography (PET) images show physiological and biological information through the *in-vivo* distribution of radioactive, short-lived, positron-emitting species. PET imaging shows focal and distributed regions of cancer and its metastases. PET uses in oncology include diagnosis, staging, and disease monitoring, important for prognosis and treatment decisions. Quantitative uses of PET include assessment of the degree of malignancy and target definition for radiation treatment. Hybrid PET-CT devices are being used as radiation treatment simulators.

Method and Materials: F-18-labeled Fluoro-deoxyglucose (F-18 FDG) is the most commonly used PET imaging agent. FDG shows regions of active glucose metabolism, such as local cancer, metastases, non-cancer inflammation, and normal glucose use in brain. Non-FDG PET agents can be highly specific in tissue targeting (binding), such as F-18 Misonidazole and C-11-labeled amino acids, to image tumor biology like hypoxia and cell proliferation, respectively.

Results: PET imaging has coarse spatial resolution compared to CT and MR. PET's clinical use is valued because of its great sensitivity for cancer detection. Voxel intensity and image fidelity depend on equipment design, patient size, anatomic site, and imaging study parameters. PET-CT units enable CT-based attenuation corrections and inclusion of CT information in a registered PET-CT dataset. Interest is high for PET-CT simulators. The Standardized Uptake Value (SUV) is a normalized intensity measure for quantitative indication of disease, and can be used for target delineation, with certain constraints.

Conclusion: This course reviews the basic physics of PET, uses of FDG and non-FDG PET for oncology imaging, and quantitative aspects for PET-based radiation target definition. Example images demonstrate the potential contributions and limitations of FDG and non-FDG PET oncology imaging. This review course is intended for both imaging and radiation oncology physicists.

Educational Objectives

1. Review the basics physics of PET imaging
2. Describe FDG PET imaging and oncologic indications
3. Review the uses and limitations of PET images in radiation treatment
4. Describe the SUV and other threshold parameters for target delineation
5. Review non-FDG PET imaging of tumor biology

Conflict of Interest: Research sponsored in part by Varian Medical Systems and GE Healthcare.