AbstractID: 7932 Title: CE: Functional/Molecular Imaging: PET for planning/assessment

Purpose: Positron Emission Tomography (PET) images show physiological and biological information through the *in vivo* distribution of radioactive, positron-emitting agents. PET imaging shows focal and distributed regions of cancer and its metastases. Initial PET uses in oncology include diagnosis and staging, which are important for determining treatment decisions. Current PET uses now include target definition for radiation planning followed by PET-based assessment of treatment. Hybrid PET-CT devices are beginning to be used as radiation treatment simulators.

Method and Materials: F-18-labled 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. Non-FDG PET agents can be more specific in cell targeting (binding), and can image different aspects of tumor biology, like hypoxia (FMISO, CuATSM) and cell proliferation (FLT)

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. The Standardized Uptake Value (SUV) is a normalized intensity measure for quantitative indication of disease, and can be used to identify disease or possibly for target delineation, with certain limitations. While FDG remains the most promising agent for tumor detection, other, biologically more specific agents (e.g., FMISO, CuATSM for hypoxia imaging or FLT for cell proliferation imaging) might be more appropriate for target delineation and treatment assessment.

Conclusion: This course reviews PET-CT hybrid scanning devices, uses of FDG and non-FDG PET for oncology imaging, and quantitative aspects for PET-based radiation target definition and treatment assessment. 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. Describe FDG PET imaging and oncologic indications
2. Review the uses and limitations of PET images in radiation treatment
3. Describe the SUV and other threshold parameters for target delineation
4. Review non-FDG PET imaging of tumor biology
5. Discuss quantitative aspects of PET imaging for treatment assessment

Conflict of Interest: (JDB) Research sponsored in part by Varian Medical Systems.