Oncologic Applications of Metabolic Imaging with Positron Emission Tomography

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This presentation is designed for physicians, scientists, and technologists that are new to the positron imaging fields. The learning objectives are the following: describe the principles of metabolic imaging using positron emitting tracers, understand the normal distribution of ^{18}F-fluorodeoxyglucose (FDG) in the body, discuss the clinical uses of FDG PET for oncology patients, understand the pattern and causes of false positive and false negative results. Positron imaging is unique in one respect: Positron emitters allows labeling of radiopharmaceuticals that closely mimic endogenous molecules and there is continuous developments of new biological tracers. FDG, a derivative of glucose, allows the evaluation of glucose metabolism, and is the most commonly used tracer because of the practical half-life of ^{18}F (110 minutes) compared to the other positron emitters. Most tumor cells demonstrate increased glucose metabolism. This is due, in part, to increased number of glucose transporter proteins and increased intracellular enzyme levels of hexokinase and phosphofructokinase, among others, which promote glycolysis. Although variations in uptake are known to exist among tumor types, elevated uptake of FDG has been demonstrated in various malignant primary tumors. The applications for FDG PET imaging are rapidly growing and accepted in the field of oncology. FDG PET imaging does not replace other imaging modalities such as CT, but appear to very helpful in specific situations where CT has known limitations, such as differentiation of benign from malignant indeterminate lesions on CT, staging malignant lesions, differentiation of benign from malignant lymph nodes, differentiation of post treatment changes versus recurrent tumor, and monitoring therapy. The addition of FDG PET in the evaluation of oncological patients in well defined algorithms including a combination

of imaging studies appear to be cost effective by identifying accurately patients that will benefit from invasive procedures and saving unnecessary costly invasive procedures on patients that will not benefit from them. The Health Care Financing Administration (HCFA) which regulates Medicare started reimbursement for solitary pulmonary nodule and staging non small cell lung carcinoma in January 98, and recently announced their approval for reimbursement for colorectal carcinoma, lymphoma and melanoma.