Clinical Indications of PET/CT

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PET-CT is emerging as a powerful diagnostic tool with oncologic, neurologic and cardiac indications. For the PET portion of the exam, the patient is injected with 18F-fluorodeoxyglucose (FDG), which is then taken up by cells with higher rates of glycolysis and trapped within them. Imaging is performed after approximately 1 hour to localize the areas of higher metabolism.

Patient preparation is vital to optimize the images. Prior to the exam, the patient should be NPO for 6 hours, should be well hydrated, and have a blood glucose level of less than 200 mg/ml. After the FDG injection, the patient must remain still until imaging is performed, as muscular activity can limit the usefulness of the study.

The PET data is then fused to CT images, which can be obtained in two ways. The data from a CT scan performed on a separate scanner can be fused to the PET data, or newer machines have PET and CT scanners built into the same unit. The advantage to the latter method includes that the patient does not have to move between the PET and CT, allowing for better fusion of the PET and CT data. The end result is a test that yields both physiologic and anatomical information.

Correlation of the CT with the PET data is imperative, as common artifacts such as focal muscular activity, normal bowel activity and hyper-metabolic fat are readily appreciated. Also, while PET is very sensitive, by itself it is not very specific since any area of increased metabolism will show up as positive on the scan, including areas of infection or inflammation. The addition of CT can often distinguish between the potential causes of increased metabolism.

By far the most common current indication for PET-CT is in the evaluation of neoplasms. Benefits of this exam include: localization of disease for biopsy, surgery or treatment planning, evaluation of response to treatment, and detection of recurrent or residual neoplasm. This exam has been shown to be very accurate in the diagnosis, staging and restaging of neoplasms including non small cell lung cancer, lymphoma, colorectal cancer, esophageal cancer, and melanoma.

Imaging patients with breast cancer is also useful for staging, restaging and response to treatment. It has also been shown that imaging patients with newly diagnosed and locally advanced cervical cancer is helpful for staging. Even though not currently Medicare approved, PET-CT can often be useful in the evaluation of patients with ovarian, pancreatic and renal cancers.

The evaluation of a solitary pulmonary nodule is a common clinical problem, with incidental nodules a common finding on chest radiographs and chest CT. PET-CT is an excellent method to further evaluate these nodules, and to determine the appropriate next step. The general rule is that nodules 1 cm or greater can be accurately evaluated. The main differential diagnosis of a pulmonary nodule includes a granuloma or lung carcinoma, and most granulomas are not hypermetabolic, while lung carcinomas are hypermetabolic. Therefore, if a nodule does not show abnormal activity, it can be watched with follow up imaging, while an abnormally metabolic nodule will need a more aggressive course of action including biopsy or resection.

PET-CT is currently much less commonly performed for neurologic or cardiac indications. Neurologic indications include evaluation of refractory seizures and diagnosis of Alzheimer's disease. In the evaluation of epilepsy, in the interictal state a seizure focus usually shows as an area of hypometabolism. In imaging patients with dementia, PET-CT has been shown to be accurate in differentiating Alzheimer's disease from frontotemporal dementia, and can detect Alzheimer's disease earlier than other imaging studies. Other neurologic indications, including brain tumor grading, radiation necrosis versus recurrent tumor, stroke evaluation and evaluation of Parkinson's disease are not currently approved by Medicare.

The only current cardiac indication for PET is myocardial viability following inconclusive SPECT study.

As has been previously stated, PET is also positive in the setting of infection and inflammation. These indications are not currently approved by Medicare, but much research is currently being performed. Areas under investigation include osteomyelitis, infected prosthesis, fever of unknown origin, vasculitis, inflammatory bowel disease, evaluation of the diabetic foot, and lung and pleural diseases. Some if not many of these indications will likely become common in the near future. The most promising areas include evaluation of osteomyelitis and the infected prosthesis, and PET-CT may become the single best test in the evaluation of these entities.