

Understanding Artifacts, Normal Variants on FDG-PET Images

Physiology and Pathophysiology of Incidental Findings Detected on FDG-PET Scintigraphy.

Liu Y, Ghesani NV, Zuckier LS:

Semin Nucl Med 2010; 40 (July): 294-315

In premenopausal women, ovarian and uterine FDG activity is related to the menstrual cycle.

Objective: To provide a review of the normal variants and artifacts along with incidental findings that can be seen on FDG-PET images. **Discussion:** The authors discuss the normal distribution of glucose-6-phosphatase in the body and point out that the presence of this enzyme is responsible for the low levels of FDG in normal organs other than the brain and heart. The authors discuss the impact of elevated glucose levels on FDG tumor uptake. They cite one study that found that doubling the baseline glucose levels led to a 42% decrease in tumor SUV. They point out that since tumor uptake of FDG continues to rise after injection, it is important to perform follow-up PET imaging using the same time interval after injection as that for baseline imaging. There is a brief discussion about use of high-density oral contrast causing artificial increase in FDG as a result of the contrast-induced increase in Hounsfield units used for attenuation correction. The authors show a nice example of diffuse muscle uptake that occurred secondary to food intake several hours before the exam and caused elevated insulin levels. The authors discuss the partial volume effect and remind us that lesions smaller than twice the spatial resolution are subject to this phenomenon. They point out that increased uptake in the region of the vocal cords and sometimes the tongue is due to the patient speaking after injection. In contrast, unilateral vocal cord uptake is usually due to contralateral vocal cord paralysis. The article goes on to address normal physiologic uptake in thymus, breasts, and bowel. It notes that FDG levels in the spleen greater than in the liver are abnormal. The authors point out that in premenopausal women, ovarian and uterine FDG activity is related to the menstrual cycle whereas in postmenopausal women there should not be significant uptake in these organs. They also discuss the many regions of the body where brown fat FDG uptake may be seen, particularly in cold weather or cold injection rooms. Incidental focal findings in the thyroid, breast, bowel, and heart, which may represent unexpected sites of tumor, are discussed as well.

Reviewer's Comments: There is quite a bit more to this article than time permits me to discuss, including a large number of excellent case examples. Although much of the contents of this article will be review for most of you, it is still worth a closer look if PET/CT is part of your practice. (Reviewer-David Bushnell, MD).

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Keywords: PET-FDG Artifacts

Print Tag: Refer to original journal article

Reliable I-131 MIBG Dosimetry Can Be Achieved With a Standard Imaging Protocol

Dosimetry for 131I-MIBG Therapies in Metastatic Neuroblastoma, Pheochromocytoma and Paraganglioma.

Sudbrock F, Schmidt M, et al:

Eur J Nucl Med Mol Imaging 2010; 37 (July): 1279-1290

Although the tumor dosimetry relies on conjugate view whole-body scans, the authors note that serial SPECT CT scans would provide better quantitation.

Background: The success of radionuclide therapy with 131I-MIBG has been variable. One area of concern is the inconsistent way dosimetric information has been acquired and used.

Objective: To evaluate a standardized protocol for 131I-MIBG in patients undergoing radionuclide therapy for neuroendocrine cancers.

Participants/Methods: 21 patients were included in this investigation (14 children with neuroblastoma and 7 adults with neuroblastoma, pheochromocytoma, and paraganglioma) and each received 444 MBq/kg (12 mCi/kg) of 131I-MIBG. Anterior and posterior whole-body activity measurements were obtained using a scintillation probe positioned 4.5 meters from the patient. In total, 20 to 50 measurements were acquired over 5 to 6 days post-administration. Tumor and organ doses were determined from conjugate view whole-body gamma camera scans. Before release, A SPECT study was acquired of the tumor regions. The mass of the tumors was determined from a combination of the SPECT and CT or MRI scans.

Results: Whole-body absorbed doses for the children ranged from 1.8 to 2.9 Gy (180 to 290 rads), while the adult whole-body dose was 1.0 to 1.8 Gy. The absorbed dose was determined for 25 lesions that ranged in size from 1 to 80 g. Tumor doses ranged from 10 to 60 Gy and the mean tumor to body dose ratio was 18. The tumor effective half-life was 1.3 to 2.8 days for children and 1.2 to 4.6 days for adults.

Conclusions: The protocol for accurate 131I-MIBG dosimetry should include 20 probe-based whole-body measurements and 4 gamma camera conjugate view studies over at least 4 days. The authors also note that SPECT and CT studies should be used to determine tumor volumes.

Reviewer's Comments: It is easy to agree with the authors of this paper that a careful and reproducible method for obtaining dosimetric measurements is crucial for obtaining accurate dosimetry in patients undergoing 131I-MIBG therapy for neuroendocrine cancer. Although they conclude that 20 whole-body measurements are required for accurate whole-body dose estimates, they really don't provide any justification for that sampling frequency. It is difficult to understand why the sampling for whole-body doses should be 5 times higher than for tumors and inspection of the clearance curves suggests that 4 to 5 count samples would be adequate. (Reviewer-Mark T. Madsen, MD).

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Keywords: Targeted Radiotherapy, Neuroblastoma, Pheochromocytoma, MIBG, Dosimetry

Print Tag: Refer to original journal article

PET-CT Is Alternative for Cancer Screening in Patients With Myositis

Conventional Cancer Screening Versus PET/CT in Dermatomyositis/Polymyositis.

Selva-O'Callaghan A, Grau JM, et al:

Am J Med 2010; 558-562 (June): 558-562

FDG PET/CT is a good alternative to the numerous tests conducted as part of a conventional workup in the search for an underlying malignancy in patients with myositis.

Background: Patients diagnosed with dermatomyositis, and to a lesser extent polymyositis, have a small but significant risk of harboring an underlying associated malignancy. These patients usually undergo moderately extensive evaluation in an attempt to locate these malignancies.

Objective: To evaluate the accuracy of FDG PET/CT compared to a standard workup in patients with myositis.

Design: Prospective study conducted at 3 centers.

Methods: PET/CT was performed in all subjects within 4 weeks of conventional workup (CWU) for malignancy. Experienced imaging physicians were blinded to the findings from CWU and interpreted the PET/CT images with the assistance of SUV results. All patients carried a diagnosis of either polymyositis or dermatomyositis. Conventional cancer screening in this study included comprehensive physical exam, chest/abdomen diagnostic CT, blood counts and chemistry panel, CA125 and CA19.9, carcinoembryonic antigen, prostate-specific antigen, and gynecologic ultrasound and mammography in women.

Results: There were 55 patients in this study of which 9 were eventually determined to have an underlying malignancy. The most common site of the primary tumor was the breast, while other sites included the lung, pancreas, vagina, and colon. The accuracy of FDG PET/CT was statistically the same as for CWU. PET/CT was found to have a PPV of 86%, NPV 94%, sensitivity 67%, and specificity 98% compared to PPV 78%, NPV 96%, sensitivity 78%, and specificity 96%. The overall predictive value was 93% for both diagnostic approaches.

Conclusions: FDG PET/CT is a good alternative to the numerous tests conducted as part of a CWU in the search for an underlying malignancy in patients with myositis.

Reviewer's Comments: The authors did not mention cost-related issues but I strongly suspect that PET/CT would be the cheaper alternative to the CWU used in this study. In addition, the simplicity and reduced time requirements for the patient also favor using PET/CT in this clinical setting. (Reviewer-David Bushnell, MD).

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Keywords: PET/CT, Dermatomyositis

Print Tag: Refer to original journal article

PET-CT Is Accurate for Staging, Restaging Patients With Follicular NHL

Diagnostic and Prognostic Impact of 18F-FDG PET/CT in Follicular Lymphoma.

Le Dortz L, De Guibert S, et al:

Eur J Nucl Med Mol Imaging 2010; August 18 (): epub ahead of print

PET results following chemotherapy in follicular non-Hodgkin's lymphoma can be used to assess prognosis.

Background: PET/CT is widely used now in the assessment of Hodgkin's and aggressive non-Hodgkin's lymphoma (NHL). However, its use in the indolent lymphomas is less well established.

Objective: To evaluate the value of PET/CT in follicular lymphoma that accounts for the large majority of cases of low-grade lymphomas.

Design/Participants: Retrospective study of 45 patients with follicular NHL who had both PET/CT and diagnostic CT performed at the time of initial diagnosis.

Methods: All patients were treated with R-CHOP and had follow-up PET/CT and CT exams. PET/CT follow-up exams were performed after either 4 or 6 cycles of therapy. Initial PET/CT detected 87 nodal and 16 extranodal tumor sites not detected on the initial diagnostic CT exam. Five cases (11%) were upstaged from stage I/II to stage III/IV based on PET/CT results. In 18 patients, the response to chemotherapy was classified differently for PET/CT and diagnostic CT. In 16 individuals, CT showed residual mass lesions indicating non-response while PET/CT was negative. Disease progression was detected during follow-up in only 2 of these 16 cases with a median follow-up period of 3 years. Findings from PET had a strong correlation with outcome. The mean progression-free survival period based on the Kaplan-Meier method was 48 months for individuals with a negative post-chemotherapy PET compared to 17 months for patients with a positive post-chemotherapy exam. FDG standard uptake value levels did not seem to correlate with histological tumor grade in this study. However, the authors point out that the biopsy site was not necessarily the same as the tumor site used to measure tumor SUV.

Conclusions: The authors conclude, "FDG PET/CT appears to be particularly useful in the management of patients with follicular lymphoma." They go on to say that it is beneficial for both staging and assessment of response to therapy.

Reviewer's Comments: Results like these may make oncologists more likely to use PET/CT in low-grade NHL, although I imagine a larger prospective study confirming these findings will be needed to really have a major impact. (Reviewer-David Bushnell, MD).

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Keywords: PET/CT, Non-Hodgkin's Lymphoma

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Stress-to-Rest Ventricular Volumes, High-Risk CAD -- Is There a Connection?

Sex-Specific Approach to Gated SPECT Volumetric Analysis After Stress and at Rest to Detect High-Risk Coronary Artery Disease.

Hida S, Chikamori T, et al:

Nucl Med Commun 2010; July 14 (): epub ahead of print

A sex-specific adjustment of functional left ventricular analyses on gated SPECT improves the identification of high-risk disease.

Background: A limitation of SPECT myocardial perfusion imaging is the limitations of spatial resolution and its ability to detect balanced 3-vessel disease. To overcome this, several non-perfusion parameters such as transient ischemic dilation and ventricular stunning have been found to increase the diagnostic accuracy for coronary artery disease detection.

Objective: To determine whether or not sex-specific criteria are able to improve the detection of high-risk coronary artery disease (CAD) as defined by the Duke CAD Prognostic Index.

Design: Retrospective review.

Participants: 407 patients undergoing both coronary angiography and myocardial perfusion SPECT.

Methods: All patients underwent single isotope (Tc99m sestamibi) SPECT gated at rest and post-stress, as well as conventional angiography within 3 months of the nuclear scan.

Results: 102 patients were identified as high-risk and 305 as low- to intermediate-risk. The stress-to-rest end systolic ratio was 1.26 ± 0.2 in high-risk patients and 1.08 ± 0.18 in low- to intermediate-risk patients. Optimal cutoff points for the stress to rest end-diastolic and end-systolic ratios (rESV) were 1.10 (41% sensitivity and 86% specificity) and 1.11 (82% sensitivity and 60% specificity), respectively. When adjusting for sex, the optimal rESV to differentiate high-risk from intermediate-/low-risk CAD was 1.09 in men and 1.20 in women (86% sensitivity and 63% specificity).

Conclusions: Sex-specific adjustment of cutoff points for function parameters obtained at rest compared to post-stress increases the sensitivity and specificity of high-risk CAD detection.

Reviewer's Comments: It is pretty obvious that sex-specific modification of physiologic data almost always increased diagnostic accuracy. What is interesting in this paper is that the cutoff for high-risk compared to low- to intermediate-risk CAD in terms of the stress-to-rest end systolic volume ratio was pretty low at 1.09 in men. Although a computer multivariate analysis found that the summed difference score, end-diastolic ratio, and end-systolic ratio together had an accuracy of 76% for the identification of high-risk disease, how to apply these computer models to clinical practice and individual patients remains challenging. (Reviewer-Thomas F. Heston, MD).

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Keywords: Coronary Artery Disease, Quantitative Gated Single-Photon Emission CT, Sex

Print Tag: Refer to original journal article

Can Tc-99m Sestamibi Scintigraphy Detect Early Impairment of Myocardial Function?

Relation of 99mTc-Sestamibi Washout With Myocardial Properties in Patients With Hypertrophic Cardiomyopathy.

Isobe S, Ohshima S, et al:

J Nucl Cardiol 2010; July 16 (): epub ahead of print

Increased 99mTc-sestamibi washout is associated with an impaired contractile reserve and prolonged relaxation.

Background: Hypertrophic cardiomyopathy (HCM) is a genetic disease, characterized by left ventricular hypertrophy of unknown causes. The result is an increased cardiac mass with increased resistance to ventricular filling and impaired myocardial relaxation.

Objective: To determine the relationship, if any, between 99mTc-sestamibi washout and myocardial function variables in patients with HCM.

Design: Prospective cohort study.

Participants: 24 consecutive patients with nonobstructive HCM.

Methods: All patients underwent biventricular cardiac catheterization both at rest and during atrial pacing; echocardiography; and myocardial 99mTc-sestamibi scintigraphy at rest. The sestamibi washout rate (WR) was calculated comparing planar images obtained 40 minutes after injection with planar images obtained 4 hours later. Patients were stratified into 2 groups: 13 patients showing 99mTc-sestamibi WR <22.5% and 11 patients showing 99mTc-sestamibi WR ≥22.5%.

Results: There was a significant positive correlation between WR and change in pressure halftime and in the baseline left ventricular end-diastolic pressure. There also was a significant inverse correlation between the WR and percent changes in left ventricular pressure. Maximum wall thickness by echocardiography was also significantly greater in patients with an increased washout ratio >22.5% compared to those with a WR of <22.5%.

Conclusions: Increased 99mTc-sestamibi washout is associated with an impaired contractile reserve and prolonged relaxation. These data suggest that myocardial perfusion scintigraphy using 99mTc-sestamibi may be useful in the noninvasive detection of early impairment of myocardial function in HCM patients.

Reviewer's Comments: This is an interesting, well-performed research paper. To determine the heart-to-mediastinal ratio, a region of interest was placed around the entire heart (not just the left ventricular wall), which was compared to a small region of interest placed over the upper mediastinum. A greater washout of the tracer was associated with increased disease. (Reviewer-Thomas F. Heston, MD).

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Keywords: Hypertrophic Cardiomyopathy, Sestamibi, Myocardial Perfusion Imaging

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Resolution Recovery Algorithms Improve Cardiac PET

Enhanced Definition PET for Cardiac Imaging.

Le Meunier L, Slomka PJ, et al:

J Nucl Cardiol 2010; 17 (June): 414-426

Resolution recovery improves the overall image quality and reduces blurring at the edges of the PET field of view.

Background: Resolution recovery algorithms are commercially available for PET CT imaging systems. How much do they improve image quality for a specific task like PET cardiac imaging?

Objective: To evaluate the value of the high definition (HD) PET resolution recovery reconstruction algorithm applied to cardiac PET studies.

Methods: All acquisitions were performed on a Siemens Biograph-64 PET CT system. Phantom experiments used an Alderson thorax phantom with a fillable cardiac chamber. Phantom acquisitions were made both with and without inserted cardiac defects. Clinical studies included 14 18F-FDG myocardial viability studies and 15 82Rb myocardial perfusion studies. All PET studies were reconstructed with the following iterative algorithms: the standard 2D attenuation weighted OSEM iterative algorithm (AWOSEM), a 3D AWOSEM, and the HD PET algorithm. The HD PET algorithm uses measured regional point spread blurring functions to recovery resolution. The optimal number of iterations for each algorithm was obtained from the phantom data. Image quality parameters used to compare the results were the contrast between myocardium and blood pool, the contrast-to-noise ratio (CNR), and the defect contrast and size. Left ventricular functional parameters such as ejection fraction, wall motion, and wall thickening were also included.

Results: The reconstruction time for the HD PET was 50% to 90% longer than for the other algorithms. The CNR was improved by 22% and 12%, respectively, for the 2D AWOSEM and 3D AWOSEM algorithms. Both the size and contrast of the phantom defects were more accurately represented with the HD PET algorithm. In the patient studies, there was, in general, little change in the contrast between the myocardium and blood pool among the 3 reconstruction methods, but the CNR was 70% to 90% improved with the HD PET algorithm. There was no significant difference in the ejection fraction, wall motion, or wall thickening associated with the reconstruction algorithms.

Conclusions: The HD PET algorithm improved spatial resolution, contrast, contrast-to-noise ratio, and defect definition without compromising left ventricular functional information. The authors believe further evaluation of the clinical efficacy of HD PET for cardiac imaging is indicated.

Reviewer's Comments: Although this article focused on Siemens HD PET algorithm, the other major players in PET CT instruments have resolution recovery algorithms available that function similarly. It is important to thoroughly investigate these products for specific imaging tasks because it is possible that artifacts or numerical biases can be introduced that may not be manifested for tumor imaging. In addition, the fee for resolution recovery algorithms is a consideration since they are not provided as part of the base price for the PET CT systems. Scientific evaluations are necessary to demonstrate the clinical added value and to justify the additional costs. (Reviewer-Mark T. Madsen, MD).

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Keywords: High Definition, PET/CT Imaging, Myocardial Viability, 18F-FDG

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FDG Differentiates Acute vs Chronic Aortic Dissection

Imaging of Acute and Chronic Aortic Dissection By 18F-FDG PET/CT.

Reeps C, Pelisek J, et al:

J Nucl Med 2010; 51 (May): 686-691

Combined anatomic/functional information of PET-CT is critical in differentiating acute from chronic dissection, thereby allowing proper triage. The authors of this study feel that uptake correlates with areas of acute laceration.

Background: When detected by CT, it is difficult to determine if an aortic dissection (AD) is acute and potentially requiring intervention, or chronic, and not needing intervention. These authors hypothesize that acute dissection will evidence metabolic processes in the recently lacerated vessel.

Objective: To analyze FDG uptake in the aortic wall of acute and chronic dissection.

Design: Prospective descriptive study.

Participants: 18 consecutive patients with clearly acute (11) or chronic stable (7) type B dissections were included. Two acute patients had acute symptomatic distal progression of known preexisting type B dissection.

Methods: Acute patients were admitted to the ICU. After 3 to 13 days, they underwent multi-slice FDG-PET including contrast-enhanced CT angiography of the aorta. In patients with asymptomatic chronic stable AD, PET-CT was performed on an outpatient basis. Imaging was performed 90 minutes post-injection. Imaging results were evaluated independently by a nuclear medicine specialist and a vascular surgeon and included both CT morphology and FDG uptake. The maximum standard uptake value (SUV_{max}) was determined in the dissected aortic wall, dissection membrane, and in the adjacent lumen. A ratio of uptake in the dissected aortic wall or membrane to the adjacent aortic lumen was calculated.

Results: Maximum diameter of the aorta in patients with acute AD did not significantly differ from that in patients with chronic stable AD. In patients with acute AD, increased FDG was noted in the membrane and in the adjacent aortic wall, as visually assessed. In asymptomatic patients with chronic and proven stable dissection, no noticeable uptake was apparent. When assessed by SUV_{max} , a statistically significant difference was noted between the 2 groups. A superior differentiation between groups was noted when the mural uptake was normalized by the adjacent blood pool SUV (ie, a ratio of wall to lumen was used).

Conclusions: Combined anatomic/functional information of PET-CT is critical in differentiating acute from chronic dissection, thereby allowing proper triage. The authors feel that uptake correlates with areas of acute laceration.

Reviewer's Comments: The authors note a selection bias in that patients who could not tolerate a 30- to 45-minute imaging session could not be studied. We therefore do not know the imaging characteristics of this group. It is interesting to compare this paper to that of Kato, published in the same edition. Kato's group suggested that elevated uptake was due to the pathogenesis of the dissection, and correlated with severity of injury and prognosis. These authors believe the uptake is secondary to injury, and indicate an acute response, thereby helping to differentiate chronic from acute dissection. Further studies will be needed to differentiate which of these theories is correct. (Reviewer-Lionel S. Zuckier, MD).

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Keywords: Aneurysm, Dissection, Prognosis, FDG

Print Tag: Refer to original journal article

FDG Uptake Signals Unfavorable Outcome in Dissection

Uptake of 18F-FDG in Acute Aortic Dissection: A Determinant of Unfavorable Outcome.

Kato K, Nishio A, et al:

J Nucl Med 2010; 51 (May): 674-681

Standard uptake value at the site of maximum dissection at 50 minutes after injection is higher in unfavorable than in favorable outcome patients with acute aortic dissection.

Background: Acute aortic dissection (AAD), particularly the Stanford type B variety, can be followed conservatively, typically relying on careful long-term monitoring of morphologic parameters on CT. In patients with less-favorable features, timely surgical or endovascular intervention is needed. Metabolic processes including chronic inflammation and proteolysis play a crucial role in degeneration of the aortic wall. It is, therefore, not surprising that FDG uptake has been reported in diseased aortas of patients with acute aortic dissection.

Objective: (1) To compare thoracic aortic uptake of FDG in patients with AAD and normal controls, and (2) to see if FDG uptake predicts short- and mid-term outcomes in medically controlled patients with AAD.

Design: Prospective descriptive study.

Participants: 28 patients with acute aortic dissection (26 Stanford type A and 2 Stanford type B) emergently admitted to the hospital, and 14 matched controls (studied for cancer screening).

Methods: Patients had thorough laboratory tests and multiple standard enhanced CT exams performed over the following year. PET-CT was performed 12.2 ± 5.3 days after admission, with imaging at 50 and 100 minutes following FDG. Mean standard uptake value (SUV) and maximum SUV (SUV_{max}) were calculated at proximal, distal, and maximal dissection sites. Differences between patients with dissections and controls were assessed. The predictive value of clinical and imaging findings on short-term (1 month) and mid-term (6 month) outcome was assessed by statistical means.

Results: Of 28 AAD patients, 8 had unfavorable outcomes (2 deaths, 4 surgical repairs, 2 progressions). Unfavorable patients had statistically greater chest pain, radiating pain, pulse deficit, maximum dissection diameter, and mean value of HDL cholesterol. SUV_{max} and mean at 50 minutes was significantly greater in patients with AAD than in controls, and SUV at the site of maximum dissection was higher in unfavorable than in favorable outcome patients. Interestingly, this latter feature was absent at 100 minutes. Mean SUV at the site of maximum dissection independently predicted unfavorable outcome. An SUV cutoff of 3.3 demonstrated reliable predictive powers.

Conclusions: This study demonstrated the value of FDG uptake in prognosticating AAD. A proposed mechanism is presence of macrophages that mark atherosclerotic inflammation.

Reviewer's Comments: This is a useful study in giving the clinicians an additional functional parameter to assess the risk of progression of aortic aneurysms. The authors point out that this paper does not differentiate causative factors versus epiphenomena. Furthermore, there is no clear statement that the degree of uptake did not influence the disposition of the patients (ie, the presence of uptake may have induced the surgeons to operate, thereby leading to an apparent correlation between uptake and complications). (Reviewer-Lionel S. Zuckier, MD).

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Keywords: Aortic Dissection, FDG, PET-CT, Prognosis

Print Tag: Refer to original journal article

Flobetapir May Be Successful Imaging Agent From Scientific Point of View

In Vivo Imaging of Amyloid Deposition in Alzheimer Disease Using the Radioligand 18F-AV-45 (Flobetapir F 18).

Wong DF, Rosenberg PB, et al:

J Nucl Med 2010; 51 (June): 913-920

Noninvasive imaging with an 18F-labeled compound has been found useful in discriminating patients with Alzheimer disease versus normal matched controls.

Background: The amyloid-beta (A β) peptide plays an important role in the development of Alzheimer disease (AD) and is a promising target for novel treatment. A reliable biomarker for this protein would be very useful. A prior imaging agent, known as Pittsburgh compound B, has encouraging features, but is limited by its short-lived 11C radiolabel.

Objective: To initially characterize the safety, metabolism, and imaging features of a new 18F-labeled radiopharmaceutical for imaging of A β peptide.

Design: Open-label multicenter trial.

Participants: 16 patients aged >50 years with a probable diagnosis of AD and 16 healthy controls of similar age and without evidence of cognitive impairment were included.

Methods: Similar methods were obtained at each of 3 sites. Approximately 10 mCi of 18F-labeled Flobetapir was injected IV. Dynamic images were obtained over a subsequent 90 minutes; plasma metabolites were also analyzed. In a subset of 4 healthy control subjects, whole-body scans for the purpose of calculating preliminary dosimetry were obtained between 20 and 45 minutes and again from 160 to 185 minutes. Image data were registered to Talairach space. Volumes of interest were developed in the high-flow regions of the frontal, temporal, parietal, occipital, anterior cingulate, posterior cingulate, and precuneus cortical gray matter. Absolute standardized uptake values (SUVs) were generated for each time point, and SUV ratios were also calculated using either the cerebellar gray matter or the centrum semiovale white matter as references. In a subset of patients in whom adequate MRI scans were available, kinetic modeling was performed to estimate a distribution volume ratio, using the cerebellum as a reference.

Results: 1 AD patient withdrew consent after 5 minutes in the scanner; there were 5 technical failures, 4 of which were due to motion in AD patients. Flobetapir was well tolerated without safety concerns. Flobetapir accumulated in cortical regions of AD patients (especially precuneus, frontal, and temporal cortices), while minimal accumulation was seen in controls. Cortical to cerebellar ratios increased through 30 minutes and then plateaued within 50 minutes. The 50- to 60-minute period was used for further analysis. SUV ratio to cerebellum was 1.67 for AD patients versus 1.25 for controls. The distribution volume ratios were highly correlated with SUV ratios, and differences between groups were statistically significant.

Conclusions: Flobetapir appears useful in localizing to areas of probable A β plaques in a noninvasive and safe manner. Imaging 50 to 60 minutes following injection appears to be an optimal and tolerable approach.

Reviewer's Comments: This paper and other reports suggest that Flobetapir is likely to be a successful imaging agent from a scientific point of view. Whether it will be clinically successful will depend on what niche it will occupy in the diagnosis and treatment of AD. (Reviewer-Lionel S. Zuckier, MD).

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Keywords: Alzheimer Disease, PET Imaging, 18F, Amyloid Plaques

Print Tag: Refer to original journal article

More Isn't Always Better -- Less Contrast Is Good in CT Pulmonary Angiography

Contrast Opacification Using a Reduced Volume of Iodinated Contrast Material and Low Peak Kilovoltage in Pulmonary CT Angiography: Objective and Subjective Evaluation.

Hunsaker AR, Oliva IB, et al:

AJR Am J Roentgenol 2010; 195 (August): W118-W124

Using a low peak kilovoltage and high iodine concentration contrast, lowering the volume of contrast from 125 mL to 75 mL does not adversely affect the quality of CT pulmonary angiography.

Objective: To compare contrast opacification of the pulmonary arteries using 75 mL of contrast compared with the standard 125-mL dose.

Design: Retrospective study.

Participants: Consecutive patients clinically suspected of having acute pulmonary embolism who underwent CT scanning.

Methods: CTs were performed on either 16- or 64-multidetector CT (MDCT) scanners. For 16-MDCT scanners, parameters were 110 peak voltage (kVp), 120 effective mAs, and 16.0 x 0.75 mm collimation. For 64-MDCT scanners, parameters were 100 kVp, 120 effective mAs, and 64.4 x 0.6 mm collimation. In both CT scanners, a low kVp was used because it approximates the k-edge of iodine and reduces the radiation dose. Patients received either 75 mL or the standard 125 mL of iodinated contrast injected at 3.5 to 4.0 mL/second. A high-concentration iodinated contrast, iopromide 370 (Ultravist 370), was used. No saline chaser was given. Images were reconstructed with a 0.75-mm section thickness for 16-MDCT scans and 0.5-mm section thickness for 64-MDCT scans. Three chest radiologists analyzed the images. Quantitative region of interest (ROI) measurements were made at 4 different levels of the left lower lobe pulmonary artery: lobar, posterobasal segmental, and posterobasal and medial basal subsegmental rami. In addition, qualitative assessment of the degree of enhancement at each of these levels was made using a 3-point scale, where 1 = good to excellent quality, 2 = adequate quality, and 3 = non-diagnostic quality.

Results: Of 452 patients, 223 received 75 mL and 229 received 125 mL. There was no significant difference between groups in contrast opacification of the pulmonary arteries at the 4 different levels measured. The mean contrast opacification at the 4 different levels ranged from 338 to 365 Hounsfield units (HU) in those who received 75 mL of contrast and ranged from 340 to 364 HU in those who received 125 mL of contrast. The authors note that a threshold of at least 250 HU is considered optimal for evaluation of pulmonary embolism. There was a trend that did not reach statistical significance ($P=0.07$) for better contrast opacification of the left lower lobe medial basal subsegmental pulmonary artery in patients who received 75 mL of contrast. In addition, there was good concordance between objective measurements and subjective evaluation of the degree of contrast opacification at all 4 levels.

Conclusions: There is good support for using a reduced volume of contrast in CT pulmonary angiograms.

Reviewer's Comments: The authors have very nicely demonstrated that administration of more iodinated contrast is not necessarily better in the qualitative performance of CT pulmonary angiograms. (Reviewer-Vineet R. Jain, MD).

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Keywords: Pulmonary Embolism, Contrast Opacification, CT Angiography

Print Tag: Refer to original journal article

PET-CT With F-18 Fluorocholine Can Distinguish FNH From HCA

Differentiation of Hepatocellular Adenoma and Focal Nodular Hyperplasia Using 18F-Fluorocholine PET/CT.

van den Esschert JW, Bieze M, et al:

Eur J Nucl Med Mol Imaging 2010; August 18 (): Epub ahead of print

Focal nodular hyperplasia metabolizes choline at a higher rate than ordinary liver tissue.

Background: Focal nodular hyperplasia (FNH) and hepatocellular adenoma (HCA) are each hypervascular, benign liver lesions, but HCA carries a greater risk of spontaneous bleeding and malignant transformation, especially when lesions are >5 cm.

Objective: To determine whether PET/CT with 18F-fluoromethylcholine (FCH) as radiotracer can be used to differentiate FNH from HCA.

Design/Methods: This study prospectively included 21 female patients with suspicion of FNH or HCA. Lesions were >2 cm in diameter. Patients with clinical, biochemical, or radiologic features suggestive of malignancy were excluded. Study subjects were imaged with a Philips Gemini TF-16 PET/CT scanner 15 minutes after the IV administration of 150 MBq of FCH. Image readers determined the maximum standardized uptake value (SUV_{max}) of liver lesions and average SUV of surrounding liver tissue. To compensate for individual variation in hepatic metabolism of choline, image readers calculated the SUV_{max} ratio (SUV_{max}/SUV_{average}) for each patient. SUV ratios were compared with histopathologic diagnosis of the lesions following surgical excision or liver biopsy.

Results: 10 patients had FNH, and 11 had HCA. The mean SUV ratio for FNH was 1.68 ± 0.29 , and the mean ratio for HCA was 0.88 ± 0.18 ($P < 0.001$). All FNH showed increased uptake compared to surrounding liver, and all HCA showed similar or decreased uptake compared to surrounding liver. Receiver-operating characteristic analysis suggested that an SUV ratio between 1.12 and 1.22 could be used as a cut-off to differentiate FNH from HCA with 100% sensitivity and specificity.

Conclusions: PET/CT with 18F-fluorocholine can be used to differentiate HCA from FNH with high sensitivity and specificity. Results need to be replicated in a larger series of patients.

Reviewer's Comments: Given that FNH had higher uptake than surrounding liver tissue and that hepatocellular adenoma uptake was similar to or lower than normal liver, lesions can probably be distinguished visually on the scans. (Reviewer-Shayne Squires, MD).

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Keywords: Focal Nodular Hyperplasia, Hepatocellular Adenoma, PET/CT, 18F-Fluorocholine

Print Tag: Refer to original journal article

FDG PET-CT Useful as Additional Imaging Tool to Assess Extra-Axillary Metastasis

Detection of Extra-Axillary Lymph Node Involvement With FDG PET/CT in Patients With Stage II–III Breast Cancer.

Aukema TS, Straver ME, et al:

Eur J Cancer 2010; August 16 (): epub ahead of print

FDG PET/CT can result in modification of radiotherapy fields in patients with stage II to III breast cancer.

Background: Nodal metastases outside the axilla may be present in up to 56% of breast cancer patients. Extra-axillary nodes are not routinely treated surgically and carry a worse prognosis. They may suggest the need to modify regional radiotherapy.

Objective: To determine the incidence of extra-axillary lymph node involvement in patients with stage II to III breast cancer using FDG PET/CT.

Design/Methods: This study prospectively included 60 patients with invasive breast cancer at least 3 cm in diameter and/or at least one tumor-positive axillary lymph node. Patients underwent PET/CT scanning with FDG prior to receiving neoadjuvant chemotherapy. Images were interpreted in consensus by 3 experienced readers who evaluated the intensity, extent, and location of focal FDG uptake. A cutoff maximum standard uptake value (SUV_{max}) of 2.5 was used to distinguish malignant from benign lymph nodes.

Results: Extra-axillary lymph nodes were detected by FDG PET/CT in 17 patients (28%). Sites of nodal involvement included intra-mammary (1 node), mediastinum (2 nodes), internal mammary chain (9 nodes), intra- and interpectoral (6 nodes), infraclavicular (5 nodes), and contralateral axilla (3 nodes). The mean SUV_{max} of involved lymph nodes was 5.5 (range, 2.6 to 9.9). FDG PET/CT upgraded the TNM stage in 10 patients (17%). The initial radiotherapy plan was changed in 7 patients (12%) based on extra-axillary lymph node detection. In 4 patients with positive internal mammary chain or mediastinal involvement, the radiotherapy target volume was adjusted to include the affected regions. Two patients received radiation to the contralateral axilla based on detection by FDG PET/CT.

Conclusions: FDG PET/CT may detect extra-axillary lymph node involvement in nearly one third of patients with stage II to III breast cancer and can impact management in patients who will undergo neoadjuvant chemotherapy.

Reviewer's Comments: More data are needed to demonstrate that inclusion of the internal mammary chain in the radiation field improves survival in patients with stage II to III breast cancer, but allocation of patients to radiotherapy of the internal mammary chain according to PET findings may result in better demonstration of benefit. (Reviewer-Shayne Squires, MD).

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Keywords: Breast Cancer, Lymph Nodes, FDG PET/CT

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PET-CT With Ga-68 DOTATATE Useful for Predicting Response to Tx

68Ga-DOTATATE PET/CT for the Early Prediction of Response to Somatostatin Receptor–Mediated Radionuclide Therapy in Patients With Well-Differentiated Neuroendocrine Tumors.

Haug AR, Auernhammer CJ, et al:

J Nucl Med 2010; 51 (September): 1349-1356

Change in ratio of tumor maximum standard uptake value (SUV_{max}) to spleen SUV_{max} is more predictive of response to therapy than change in tumor SUV_{max} only.

Background: Somatostatin receptor imaging with SPECT using ^{111}In -pentetate has been shown to be superior to morphologic imaging with CT for predicting the clinical outcome of patients with neuroendocrine tumors. Until recently, there have been no studies similarly evaluating PET imaging with ^{68}Ga -DOTATATE for the prediction of response to therapy.

Objective: To assess the ability of PET/CT with ^{68}Ga -DOTATATE to predict progression-free survival and clinical outcome in patients with neuroendocrine tumors following the first cycle of peptide receptor radionuclide treatment.

Participants/Methods: This study included 33 consecutive patients with histologically proven, well-differentiated neuroendocrine tumor undergoing 1, 2, or 3 cycles of therapy with 3700 MBq of ^{90}Y -DOTATATE ($n=24$), 7400 MBq of ^{177}Lu -DOTATATE ($n=7$), or both ($n=2$). Patients underwent PET/CT imaging with ^{68}Ga -DOTATATE prior to radiotherapy and again at 3 months after the first cycle of radiotherapy. Eight of the patients were treated with long-acting somatostatin analogs during both pre- and post-therapeutic PET/CT image acquisitions. Image interpreters determined the maximum standard uptake value (SUV_{max}) of up to 3 tumors in 4 organs (liver, lung, lymph nodes, and bone) and the SUV_{max} of the spleen in each patient. Any change in tumor SUV_{max} or ratio of tumor SUV_{max} to spleen SUV_{max} ($SUV_{T/S}$) following the first cycle of treatment was considered a positive response to therapy.

Results: Mean follow-up time was 22.3 ± 5.1 months. The 23 patients who showed a decrease in $SUV_{T/S}$ following initial therapy had a significantly longer time to progression than did those without a decrease (median time to progression not reached vs 6 months, $P=0.002$). Change in tumor SUV_{max} following therapy was not a statistically significant predictor of time to progression. Interestingly, splenic SUV_{max} was higher after therapy than before therapy ($P=0.05$). Change in $SUV_{T/S}$ remained a significant predictor of time to progression regardless of treatment with long-acting somatostatin analogs.

Conclusions: ^{68}Ga -DOTATATE PET/CT can predict progression-free survival in patients with well-differentiated neuroendocrine tumor receiving treatment with peptide receptor radionuclide therapy.

Reviewer's Comments: The authors also looked at change in tumor SUV_{max} and $SUV_{T/S}$ to predict symptomatic response to therapy. There was a correlation for both parameters, but the predictive power was less than perfect. Consequently, patients may benefit from peptide receptor radionuclide therapy even if ^{68}Ga -DOTATATE imaging predicts a shorter time to progression. (Reviewer-Shayne Squires, MD).

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Keywords: Neuroendocrine Tumors, ^{68}Ga -DOTATATE, Somatostatin Receptor Imaging

Print Tag: Refer to original journal article

PET-CT Can Identify Response to Tyrosine Kinase Inhibitors in NSCLC

Is 18F-FDG PET/CT Useful for the Early Prediction of Histopathologic Response to Neoadjuvant Erlotinib in Patients With Non-Small Cell Lung Cancer?

Aukema TS, Kappers I, et al:

J Nucl Med 2010; 51 (September): 1344-1348

Decrease in tumor metabolic activity by PET/CT in response to erlotinib therapy correlates with tumor necrosis by histopathologic analysis.

Background: Erlotinib is a member of the class of epidermal growth factor receptor tyrosine kinase inhibitors. There is an ongoing Dutch multicenter phase II trial of neoadjuvant erlotinib in operable non-small-cell lung cancer (NSCLC).

Objective: To evaluate the ability of 18F-FDG PET/CT to predict response to neoadjuvant erlotinib early in the course of erlotinib therapy in patients with NSCLC.

Methods: Patients with stage I to III NSCLC were included in a trial to evaluate response to and toxicity from erlotinib therapy (3 weeks duration), which was followed by surgical resection. A baseline FDG PET/CT scan was obtained during staging and another was obtained within 7 days after the initiation of erlotinib therapy. Patients with more than a 25% decrease in maximum standard uptake value (SUV_{max}) in response to initiation of therapy were classified as metabolic responders. Histopathologic response was evaluated from surgical specimens that were examined for the presence of necrosis and residual vital tumor.

Results: This study included 23 patients for whom there was a PET/CT at baseline and a PET/CT within 7 days of initiation of erlotinib therapy. The median SUV_{max} at baseline was 11 and the median SUV_{max} following one week of erlotinib therapy was 9.3. In metabolic responders, there was a median percentage of necrosis in resected tumor specimens of 70%. In metabolic nonresponders, there was a median percentage necrosis of 40% ($P=0.09$). The κ agreement between response by SUV_{max} and pathologic response was 0.55 ($P=0.008$).

Conclusions: This study suggests that early in the course of therapy with erlotinib, 18F-FDG PET/CT can be used to identify response in most patients. This study was relatively small, but the results are promising and consistent with preclinical studies.

Reviewer's Comments: If PET/CT could be used to allocate patients more likely to respond to experimental therapies in clinical trials, trials could be smaller in size and shorter in duration, saving millions of dollars. (Reviewer-Shayne Squires, MD).

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Keywords: Lung Cancer, PET/CT, Tyrosine Kinase Inhibitors, FDG

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Hybrid Cardiac PET-CT More Accurate for Detecting CAD Than Either Modality Alone

Cardiac Positron Emission Tomography/Computed Tomography Imaging Accurately Detects Anatomically and Functionally Significant Coronary Artery Disease.

Kajander S, Joutsiniemi E, et al:

Circulation 2010; 122 (August 10): 603-613

Combining coronary CT angiography and myocardial PET reduces the false-positive rate of each modality.

Background: Coronary CT angiography (CTA) has high negative predictive value for detecting coronary artery disease (CAD), but it is often unable to discriminate flow-limiting lesions from nonsignificant lesions.

Objective: To evaluate the accuracy of hybrid cardiac PET/CT imaging compared to either modality alone.

Participants/Methods: This study prospectively included 107 patients with stable chest pain and no prior diagnosis of CAD with an estimated pretest probability of 30% to 70% of having CAD. Exclusion criteria included unstable angina, severe heart failure, second- or third-degree heart block, renal failure, asthma, atrial fibrillation, and pregnancy. All patients underwent coronary CTA and myocardial PET perfusion imaging with the PET/CT hybrid scanner, followed by invasive coronary angiography (ICA) within 2 weeks. PET imaging was performed at rest and following stress with adenosine using $^{15}\text{O-H}_2\text{O}$ as radiotracer. Fractional flow reserve (FFR) was performed during ICA for intermediate-sized lesions. Analysis was done on a per-patient and per-vessel basis. Stenoses $<50\%$ or with $\text{FFR} >0.8$ were classified as nonsignificant. ICA and FFR results were used as the gold standard.

Results: CTA alone had a positive-predictive value (PPV) of 81%, negative-predictive value (NPV) of 97%, and an accuracy of 90% per patient. On a per-vessel basis, CTA PPV, NPV, and accuracy were 76%, 94%, and 91%, respectively. In a patient-based analysis, stress perfusion imaging had a PPV of 86%, NPV of 97%, and accuracy of 92%. On a per-vessel basis, stress perfusion imaging had a PPV of 78%, NPV of 98%, and accuracy of 92%. Combined modality imaging (PET and CTA) resulted in a per-patient PPV, NPV, and accuracy of 100%, 97%, and 98%, respectively. Per-vessel, hybrid imaging had a PPV of 96%, NPV of 99%, and accuracy of 98%. Hybrid imaging was more accurate per patient than CTA alone ($P=0.0039$) or PET alone ($P=0.014$) and was more accurate on a per-vessel basis as well ($P<0.0001$). A myocardial blood flow (by PET) of 2.5 mL/g/minute gave the most accurate cutoff value for detecting significant CAD.

Conclusions: Combining coronary CTA and myocardial PET results in more accurate detection of significant CAD than either modality alone. The largest effect was in reducing the number of false positives.

Reviewer's Comments: One of the interesting findings in this study was the diagnostic value of myocardial blood flow; the area under the receiver-operating characteristic curve for myocardial blood flow was 0.9516. Combining this information with hybrid imaging wasn't done in this study, but one suspects that this would result in extremely high accuracy. (Reviewer-Shayne Squires, MD).

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Keywords: Coronary Artery Disease, PET/CT, Hybrid Imaging

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FDG-PET Predicts Response to Radioimmunotherapy in Follicular Lymphoma

FDG-PET in the Assessment of Patients With Follicular Lymphoma Treated By Ibritumomab Tiuxetan Y 90: Multicentric Study.

Lopci E, Santi I, et al:

Ann Oncol 2010; 21 (September): 1877-1883

A 3-month post-therapy PET scan is the strongest predictor of progression-free survival in patients receiving Zevalin for follicular lymphoma.

Background: FDG-PET has been shown to be an excellent predictor of response to conventional chemotherapy in patients with follicular lymphoma.

Objective: To assess whether FDG-PET can be used to predict response to therapy with 90Y-ibritumomab tiuxetan (Zevalin®) in patients with relapsed or refractory follicular lymphoma.

Design/Participants: Retrospective study involving 59 patients who underwent radioimmunotherapy with Zevalin. Each patient had histologically proven refractory or relapsed follicular lymphoma.

Methods: Patients were restaged at baseline prior to therapy, according to Ann Arbor classification criteria. Part of initial staging prior to therapy included FDG-PET scanning. A second PET scan was obtained at 3 months after therapy. Based on PET/CT findings, patients were classified as complete responders, partial responders, having stable disease, or having progression of disease. Patients were followed up for a median of 23 months (range, 3 to 55 months) after Zevalin therapy.

Results: Disease extent prior to therapy predicted progression-free survival (PFS). Patients with a tumor maximum standard uptake value (SUV_{max}) of <6 in the pre-therapy PET ($n=14$) had significantly longer PFS than did patients with an SUV_{max} of ≥ 6 ($n=45$), with a projected 3-year PFS of 49% versus 13%, respectively ($P=0.038$). Patients with a negative 3-month post-therapy PET ($n=27$) had a significantly longer PFS than did PET-positive patients ($n=32$), with a projected 3-year PFS of 40% versus 10%, respectively ($P<0.00001$). In multivariate analysis, the only significant independent predictor of PFS was 3-month post-therapy PET ($P<0.001$).

Conclusions: The main predictors of PFS in patients undergoing Zevalin therapy for follicular lymphoma are extent of disease at baseline and response to therapy at 3 months, both assessed by FDG-PET. The only independent predictor is PET appearance at 3 months post-therapy.

Reviewer's Comments: In this study, there was no difference in response to Zevalin therapy between patients who received >2 prior lines of treatment and those who received ≤ 2 . (Reviewer-Shayne Squires, MD).

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Keywords: Follicular Lymphoma, PET, Radioimmunotherapy

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Interim Imaging With FDG-PET Predicts Tx Success in Hodgkin Lymphoma

18F-FDG PET After 2 Cycles of ABVD Predicts Event-Free Survival in Early and Advanced Hodgkin Lymphoma.

Cerci JJ, Pracchia LF, et al:

J Nucl Med 2010; 51 (September): 1337-1343

FDG-PET following 2 cycles of chemotherapy in patients with Hodgkin lymphoma is the most significant predictor of treatment success.

Background: The widely accepted International Prognostic Score (IPS) in advanced Hodgkin lymphoma has very limited ability to predict treatment outcome.

Objective: To assess the prognostic value of 18F-FDG PET after 2 cycles of doxorubicin, bleomycin, vinblastine, and dacarbazine (ABVD) therapy in Hodgkin lymphoma.

Design/Participants: Prospective study of consecutive patients with newly diagnosed, biopsy-proven classic Hodgkin lymphoma. Patients were classified as low risk according to an IPS of 0 to 2, or as high risk with an IPS of 3 to 7.

Methods: All patients were staged using physical examination, complete blood cell counts, blood chemistry, CT scans (cervical, thoracic, abdominal, and pelvic), bilateral bone marrow biopsy, and baseline 18F-FDG PET. Repeat PET imaging was performed after 2 cycles of ABVD (PET2). PET2 images were interpreted as negative if no pathologic FDG uptake was seen at any site. Minimal residual uptake (MRU) was defined as low-grade FDG uptake that was less than, equal to, or only slightly higher than mediastinal blood pool uptake. Patients with MRU were considered PET-negative for the study analysis.

Results: The study included 104 patients who underwent PET2 imaging. Median follow-up time was 36 months. For prediction of treatment failure, PET2 had an overall sensitivity of 72.2%, specificity of 82.9%, positive-predictive value of 53.3%, and negative-predictive value of 91.8%. There was a trend toward higher accuracy in patients with a low-risk IPS versus those with a high-risk IPS, but the difference was not statistically significant. PET2-negative patients had a 3-year event-free survival rate (EFS) of 90.5%; PET2-positive patients had a 3-year EFS of 53.4%. PET2 was the only factor significantly associated with treatment failure.

Conclusions: PET2 is the most significant predictive factor in patients undergoing ABVD therapy for Hodgkin lymphoma. A negative interim PET study is highly predictive of treatment success.

Reviewer's Comments: MRU is sometimes a diagnostic dilemma for PET readers. Of 12 patients with MRU in this study, 1 presented with relapse during follow-up. (Reviewer-Shayne Squires, MD).

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Keywords: Hodgkin Lymphoma, FDG-PET, Prognostic Value

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Viability Myocardium Varies, According to Imaging Method

Quantity of Viable Myocardium Required to Improve Survival With Revascularization in Patients With Ischemic Cardiomyopathy: A Meta-Analysis.

Inaba Y, Chen JA, Bergmann SR:

J Nucl Cardiol 2010; 17 (August): 646-654

The amount of viable myocardium for which revascularization would be beneficial varies among various imaging modalities of myocardial FDG-PET/CT, SPECT, and stress echocardiography.

Background: Myocardial ischemia is the leading cause of heart failure. In the management of these patients, determination of the amount of viable myocardium is often sought, as several studies have shown that revascularization yields a survival benefit. However, the optimal amount of viable myocardium that would actually yield benefit if revascularization occurs is unclear.

Objective: To examine the results of almost 30 studies to determine the optimal cutoff among various imaging modalities used for this purpose (myocardial FDG-PET, SPECT, and stress echocardiography).

Design: Meta-analysis of several studies regarding detecting viable myocardium to determine optimal cutoff values for which revascularization actually yields benefit.

Methods: 5 electronic databases were searched for studies involving the determination of viable myocardium among patients with ischemic cardiomyopathy, excluding those in which the study was performed only 1 month following an acute cardiac event. The primary outcome sought was cardiac mortality at time of maximum follow-up.

Results: A total of 29 studies comprising 4167 patients were included, with a mean follow-up time of 28 months. Investigators found that, when compared to medical treatment alone, revascularization provided a similar degree of survival benefit among patients in whom viable myocardium was found, regardless of imaging technique, and that no benefit was seen when revascularization was performed in patients in whom no viability was found. It was also found that the optimal amount of viable myocardium in which revascularization offered benefit was 26%, 36%, and 39% for myocardial FDG-PET, stress echo, and myocardial SPECT, respectively.

Conclusions: The amount of viable myocardium for which revascularization is beneficial varies among different imaging modalities.

Reviewer's Comments: This intriguing study suggests a not-so-insignificant difference among varying imaging modalities in determining the amount of viable myocardium. Although this study is an evaluation of several, with all the variations that entail, the findings are important in that they suggest that there is no one optimal cutoff value for all modalities. As the investigators imply, these differences likely reflect different aspects of myocardial function that the modalities evaluate, with stress echo evaluating contractile reserve, FDG myocardial PET evaluating presence of metabolism, and myocardial SPECT evaluating presence of intact myocardial cell membranes. The authors also imply that these values should be used only as a loose guideline, as management options should be individualized based on the projected risk of sudden cardiac events in each patient, particularly among patients in whom viable territories are small. (Reviewer-Damita Thomas, MD).

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Keywords: Ischemic Cardiomyopathy, Myocardial Viability, PET, Echocardiography, SPECT

Print Tag: Refer to original journal article

Is F-18-Choline Involved in Inflammatory Processes?

18F-Choline PET/CT Physiological Distribution and Pitfalls in Image Interpretation: Experience in 80 Patients With Prostate Cancer.

Schillaci O, Calabria F, et al:

Nucl Med Commun 2010; 31 (January): 39-45

18F-Choline is seen in benign inflammatory conditions. As such, just as with FDG-PET/CT, this can be a potential pitfall in the interpretation of PET studies using this tracer.

Background: 18F-Choline PET/CT is increasingly being evaluated as an imaging agent in the evaluation of patients with prostate cancer. Imaging the increased lipid cell membrane turnover seen in malignancies, including prostate cancer, this agent has been shown to be more accurate in the detection of nodal and bony metastases than is FDG-PET/CT. As such, it is important to be familiar with the abnormal and/or normal uptake patterns of the tracer to accurately interpret 18F-choline PET images.

Objective: To evaluate physiological uptake of 18F-fluorocholine (FCH) on PET in patients undergoing evaluation of prostate cancer to aid in the evaluation of this tracer for this purpose.

Participants/Methods: 80 patients with proven prostate cancer underwent 18F-FCH PET/CT for either primary staging or for evaluation of biochemical failure. All available information in the 3 to 6 months preceding imaging was used in the interpretation of 18F-FCH PET/CT images.

Results: Investigators found intense physiologic uptake in the liver and pancreas, moderate physiologic uptake in the salivary/lacrimal glands, spleen, and kidneys/urinary tract (the latter due to renal excretion), and low-grade physiologic uptake in the small and large bowels, as well as bone marrow. Uptake in reactive lymph nodes of the axilla, mediastinum, and abdominal lymph nodes was also seen. These nodes, except for abdominal nodes, were confirmed reactive with biopsy. In the patient with abdominal nodal uptake, extensive supradiaphragmatic lymphadenopathy was seen as well, with the biopsy revealing lymphoma. Other inflammatory foci were seen, including a focus of thyroiditis, esophagitis, and mastoiditis. These were thought to be inflammatory in nature due to the lack of abnormality seen on the co-registered CT. Of note, concerning uptake was seen in the brain, with confirmatory MRI revealing low-grade brain tumors.

Conclusions: The authors state that knowledge of physiological uptake is important in the interpretation of this new tracer. They also stress that knowing that 18F-FCH uptake is seen in inflammation, this can pose a pitfall in image interpretation.

Reviewer's Comments: It remains to be seen if use of 18F-FCH PET/CT will become common practice in management of patients with prostate cancer or other malignancies for that matter. However, as interests grow in this tracer for imaging, knowing the physiological uptake is important for accurate image interpretation. Despite useful information regarding physiologic, as well as benign, inflammatory uptake of this tracer discussed in this study, the authors neglected to note its uptake in regions suspicious for prostate cancer. This would have been useful as well, as this tracer is being evaluated for staging and/or restaging of prostate cancer. Given the number of patients evaluated, a report on 18F-FCH uptake in this cohort may have shed more light on its use for this purpose. (Reviewer-Damita Thomas, MD).

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Keywords: Abnormal Uptake, Biodistribution, 18F-Choline, Prostate Cancer

Print Tag: Refer to original journal article

Combo Imaging Better Detects Uterine Sarcomas

Use of 18F-Fluorodeoxyglucose Positron Emission Tomography for Diagnosis of Uterine Sarcomas.

Nagamatsu A, Umesaki N, et al:

Oncol Rep 2010; 23 (April): 1069-1076

The combined use of serum lactate dehydrogenase levels and FDG-PET improves the diagnostic accuracy for detecting uterine sarcomas.

Background: Uterine sarcomas represent <5% of all uterine malignancies. Although rare, the prognosis for the disease is quite poor. Although CT and MRI are used, they have difficulty differentiating sarcoma from its benign leiomyoma counterpart. As FDG-PET has been used extensively in the evaluation of other malignancies, this study aims to evaluate its role in this rare gynecological cancer.

Objective: To evaluate use of FDG-PET in the diagnosis of uterine leiomyomas and uterine sarcomas, including leiomyosarcomas.

Participants/Methods: 53 patients were evaluated; 24 had leiomyomas or suspected leiomyomas, 4 had leiomyosarcomas, 5 had carcinosarcoma, 1 had endometrial sarcoma, and 19 had endometrial cancer. Degree of FDG uptake was evaluated in each patient, with that in endometrial cancer patients used as a reference (since more is known about the hypermetabolic behavior of this cancer). Immunohistological staining of the glucose transporter (GLUT)-1 from surgicopathologic specimens of a subset of patients who underwent resection was performed to evaluate for a correlation between FDG uptake and GLUT-1 expression. Serum CA-125 and lactate dehydrogenase (sLDH) levels were also evaluated, as elevation of the former is known in gynecological malignancies, and elevations of the latter is more specific among uterine sarcomas.

Results: Investigators found that FDG uptake was significantly higher among patients with one of the sarcoma subtypes and endometrial cancer compared to having benign leiomyomas. They also found that sLDH levels were significantly higher among patients with one of the sarcoma subtypes versus those with leiomyomas and even those with endometrial cancer. They also found that, although FDG-PET and sLDH levels were equally sensitive (100%), FDG-PET was not as specific as sLDH levels (73% vs 87%), yielding accuracies of 79% and 89%, respectively. When combined, diagnostic accuracy improved to 100%.

Conclusions: The results of this study suggest that FDG-PET could be useful for the differential diagnosis of uterine sarcomas.

Reviewer's Comments: This study suggests that FDG-PET may be beneficial in the diagnosis of disease. The increased hypermetabolic activity seen among patients with actual disease versus those with benign leiomyomas is an important note, in that it suggests that FDG-PET, unlike conventional imaging modalities CT and MRI, can differentiate benign leiomyoma from its malignant counterpart. This is also supported by the fact the GLUT-1 expression was upregulated in specimens with cancer versus benign tumors. Because this disease is so rare, the study suffers from an extremely small number of patients with leiomyosarcoma. It would be interesting to see whether similar results are found among a larger study population. (Reviewer-Damita Thomas, MD).

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Keywords: 18F-FDG PET, Uterine Sarcoma, Leiomyosarcoma, Lactate Dehydrogenase

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