Predict Diabetic Morbidity Via Delayed Gastric Emptying Scintigraphy

Delayed Radionucleotide Gastric Emptying Studies Predict Morbidity in Diabetics With Symptoms of Gastroparesis.

Hyett B, Martinez FJ, et al:

Gastroenterology 2009; 137 (August): 445-452

Delayed gastric emptying on scintigraphy in diabetics has been correlated with an increased risk of coronary artery disease, hypertension, and retinopathy.

**Background:** Delayed gastric emptying is present in 55% of patients with type 1 diabetes and a third of patients with type 2 diabetes. Symptoms of gastroparesis include nausea, discomfort following eating, vomiting, postprandial pain, abdominal bloating, and a general feeling of fullness.

**Objective:** To assess the utility of scintigraphic gastric emptying studies to predict the morbidity from diabetic gastroparesis.

**Design:** Retrospective study covering 8 years.

**Participants:** Subjects in group A had a diagnosis of gastroparesis by both symptoms and delayed gastric emptying on nuclear medicine study. Those in group B had symptoms of gastroparesis but normal gastric emptying on nuclear medicine study. Group C consisted of diabetic patients without symptoms of gastroparesis who did not undergo a nuclear medicine gastric emptying study.

**Methods:** Delayed gastric emptying was defined as <50% emptying at 50 minutes. Using a radiolabeled egg as a protein meal, imaging was performed in the supine position for 2 hours. During the final year of the study, the definition of delayed gastric emptying was changed to <90% emptying at 4 hours in accordance with revised guidelines which directed the imaging to be continued an additional 2 hours.

**Results:** Compared to groups B or C, group A had significantly more hospital days and significantly more hospitalizations, emergency department (ED) visits, and office visits. There were more deaths per 100 patient days in group A compared with group C, but the trend did not reach statistical significance. Comparing group B with group C, there were no significant differences in days in hospital, number of hospitalizations, ED visits, or deaths. Hypertension, coronary artery disease (CAD), and retinopathy were each significantly more common in group A.

**Conclusions:** Patients with gastroparetic symptoms and significant delay on gastric emptying scintigraphy and those with gastroparetic symptoms but a normal radionuclide study have dramatic differences in their overall outcomes. Specifically, delayed gastric emptying on scintigraphy is superior to symptoms in predicting important complications of diabetes, including CAD, hypertension, and retinopathy.

**Reviewer's Comments:** The authors seem to have achieved more than their stated goal: namely to assess whether gastric emptying scintigraphy was any better than symptoms to predict morbidity in diabetes. Scintigraphy beat symptoms in the prognosis competition. Equally important for clinicians, the findings provide first-time data correlating delayed gastric emptying with some of the most serious complications of diabetes: CAD, hypertension, and retinopathy. This paper is likely to heighten the awareness of endocrinologists, gastroenterologists, and cardiologists as to the clinical significance of diabetic gastroparesis and the importance of documenting it via gastric emptying scintigraphy. (Reviewer-C. Richard Goldfarb, MD).

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Keywords: Gastric Emptying Scintigraphy, Diabetic Gastroparesis

Print Tag: Refer to original journal article
Improve Diagnostic Accuracy of Diabetic Foot Infection With SPECT/CT

Diabetic Foot Infection: Usefulness of SPECT/CT for 99mTc-HMPAO-Labeled Leukocyte Imaging.

Filippi L, Uccioli L, et al:


SPECT-CT improves the diagnostic accuracy of labeled leukocyte scan in osteomyelitis of the diabetic foot.

**Background:** Accurate diagnosis of osteomyelitis is critical for deciding the treatment modality and potential need for surgery in diabetic patients with foot infections. For radionuclide diagnosis of osteomyelitis in the diabetic foot, usually a combination of planar labeled white blood cell (WBC) scan and bone scan is used. **Objective:** To evaluate the utility of integrated SPECT/CT imaging with Tc-99m HMPAO-labeled leukocytes in imaging diabetic foot infection. **Participants:** 18 consecutive diabetic patients with 20 foot lesions suggestive of infection. **Methods:** Antibiotics were stopped for at least 20 days before labeled WBC imaging. Planar labeled WBC imaging was obtained at 30 minutes, 4 hours, and 24 hours after injection of labeled WBCs. SPECT/CT was obtained at 6 hours after injection. Initially, planar and SPECT images were interpreted without the SPECT/CT fusion images. Subsequently, SPECT/CT fusion images were reviewed and compared with planar and SPECT images. The final diagnosis was established with clinical follow-up in all patients and with histologic diagnosis in 14 lesions. **Results:** One patient was excluded from analysis because of misalignment of SPECT and CT data. Of the 16 lesions showing increased uptake of labeled WBCs, 8 lesions had a final diagnosis of osteomyelitis. In 1 patient believed to have only soft tissue infection based on planar and SPECT imaging, SPECT/CT identified uptake of labeled WBC in the adjacent bone, correctly diagnosing osteomyelitis. In another patient, SPECT/CT identified osteomyelitis in addition to soft tissue infection demonstrated in planar and SPECT imaging. In 2 patients, SPECT/CT detected soft tissue infection in addition to osteomyelitis. In 6 patients believed to have osteomyelitis based on SPECT and planar imaging, SPECT/CT localized the WBC uptake to soft tissue, correctly excluding osteomyelitis. Overall, the interpretation of the labeled WBC scans was substantially changed in 52.6% of lesions by incorporating the fusion SPECT/CT data. **Conclusion:** SPECT/CT with Tc-99m HMPAO labeled WBC can be useful for the diagnosis of osteomyelitis in diabetic foot. **Reviewer's Comments:** These pilot data with SPECT/CT suggest that SPECT/CT can accurately localize diabetic foot infection to bone versus soft tissue. This may obviate the need for a bone scan in this clinical setting. However, neuropathic joints in diabetics may demonstrate false-positive uptake of labeled leukocytes. In these patients, comparison with a bone marrow scan will be necessary. (Reviewer-Yusuf Menda, MD).

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Keywords: Diabetic Foot Infection, Osteomyelitis, SPECT/CT

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Because the marrow uptake of Lu-177 octreotate is relatively low, an average of 68% of the marrow dose comes from gamma rays originating in the surrounding tissues and organs.

**Background:** Red marrow can be the limiting critical organ in patients undergoing Lu-177 octreotate therapy for neuroendocrine cancer, but dosimetry estimates are challenging because stem cells are known to have somatostatin receptors.

**Objective:** To determine if blood activity is a reliable surrogate for red marrow activity in patients undergoing Lu-177 octreotate therapy and to determine the marrow dose contribution from surrounding source organs.

**Participants:** 15 subjects undergoing Lu-177 octreotate therapy for neuroendocrine cancer.

**Methods:** 4 to 8 days after the administration, bone marrow samples were aspirated from the iliac crest, and the radioactivity concentration was determined and compared to the radioactivity concentration in blood samples drawn at the same time. Blood dose estimates were based on 5 blood samples drawn between 0 and 168 hours after administration. All urine output was collected for the first 24 hours, and 3 SPECT studies of the abdomen were acquired between 24 to 168 hours after administration. The SPECT studies were corrected for attenuation and used to determine the cumulated activity in the liver, spleen, and kidneys for dose estimates. At 6 weeks after the treatment, blood samples were drawn to determine toxicity levels from the absorbed dose to the red marrow.

**Results:** The radioactivity concentrations in the blood and marrow aspirates were highly correlated ($r=0.91$), and the slope of the regression line was 1.35, indicating that the tissue concentrations were nearly identical. No somatostatin-specific receptor binding of the Lu-177 octreotate was found for stem cells in the aspirates. There was significant variation in marrow dose among the subjects, ranging from 80 to 932 mGy (mean, 252 mGy). There was also a very large variation in the dose contribution from external organs, ranging from 44% to 95% (average, 69%). No correlation was found between the estimated red marrow dose and the observed toxicity at 6 weeks.

**Conclusions:** Radioactivity concentrations in the blood and red marrow were identical. Therefore, blood activity concentrations can be reliably used to estimate the self-absorbed dose in the marrow. Radioactive sources in tissues and organs outside of the red marrow make a significant contribution to the marrow dose.

**Reviewer's Comments:** The kidneys are usually considered to be the critical organ for radiolabeled somatostatin therapy, but because of the gamma emissions, bone marrow toxicity is the limiting factor in approximately 70% of patients treated with Lu-177 octreotate. The authors’ findings, that the estimated dose to the marrow had no correlation with toxicity, were somewhat surprising and seem to contradict the rationale for performing individual dosimetry measurements. (Reviewer-Mark T. Madsen, PhD).

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Keywords: Bone Marrow Dosimetry, Neuroendocrine Cancer

Print Tag: Refer to original journal article
SPECT use has not declined in the PET era due to SPECT’s cheaper cost, wider availability, convenience of use, and unique applications.

An editorial in the European Journal of Nuclear Medicine and Molecular Imaging forecasts the decline of SPECT over the next decade such that cyclotrons will replace 99m Tc generators, and PET and PET/CT cameras will replace planar and SPECT instruments. However, the authors of this editorial respectfully disagree. In developed countries where PET has been clinically used for more than a decade, the number of installed PET facilities and procedures continues to increase, but increments in PET imaging have had no negative effect on the use rates for SPECT. The average time of gamma camera operation remained stable between 2003/2004 and 2006/2007. Market analysis from Frost and Sullivan predicts a 16% annual growth rate for SPECT/CT between 2008 and 2014. In Europe, single-photon procedures fell by barely 1% between 2005 and 2007, despite lung scintigraphy being replaced by pulmonary CT angiography for acute pulmonary embolism in some countries. Production of 18F-labeled agents is complex, and PET is technologically demanding. Synthesis of PET tracers is time-consuming compared with preparation of a 99mTc agent. The development of PET tracers is hampered by doubts that they would yield real clinical benefits compared with SPECT tracers. The gamma camera has the advantage over PET in worldwide availability and the longer half-life radioisotopes. Global gamma camera sales are expected to grow at an annual rate of >3%. Dynamic renal functional imaging, gastric emptying, gastrointestinal bleeding, Meckel's diverticulum detection, hepatobiliary scintigraphy, radioguided sentinel lymph node scintigraphy and biopsy, and V/Q scintigraphy are all invulnerable to PET competition. SPECT/CT is gaining recognition in evaluating thyroid carcinoma, neuroendocrine tumors, solitary pulmonary nodules, parathyroid adenomas, infection, and skeletal lesions. PET cannot offer dual-tracer imaging.

**Reviewer's Comments:** The editorialists offer persuasive evidence that single-photon imaging is here to stay for the foreseeable future. This is not a new debate — the rapid decline and eventual disappearance of SPECT were predicted when PET trendiness gained momentum several years ago. Yet gamma camera sales and single-photon tracer use have not declined. My feeling is that cost restraints and CT radiation concerns are far more likely to impact PET than SPECT. The relative use of single-photon imaging versus PET is likely to remain steady for the next several years. (Reviewer-C. Richard Goldfarb, MD).

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Keywords: SPECT, Forecast for Future Use

Print Tag: Refer to original journal article
Men with inducible hypoperfusion on myocardial perfusion imaging and limiting chest pain on treadmill stress testing are most likely to get the greatest benefit from percutaneous coronary intervention.

**Objective:** To determine if the results of myocardial perfusion scintigraphy (MPS) help predict changes in exercise capacity after percutaneous coronary intervention (PCI), and to determine the prevalence of inducible hypoperfusion on MPS in patients undergoing PCI.

**Participants:** Consecutive patients (average age, 65 years) scheduled for elective PCI after diagnostic coronary angiography were prospectively recruited. The study group was 86% male, 26% were diabetic, and 63% had stable angina.

**Methods:** Within 1 month before PCI, patients underwent single-day, single-isotope stress-rest MPS (preferentially treadmill exercise over pharmacologic stress testing). Each patient's Seattle Angina Questionnaire (SAQ) score was assessed. The interventionalists were blinded as to the results of MPS. PCI proceeded as originally planned. At about 6 months after PCI, patients returned for evaluation. Staff members performing the stress test were blinded as to the results of the baseline test. Images were evaluated with the Cedars-Sinai AutoSPECT and AutoQuant programs, along with semiquantitative summed scoring using a 17-segment 5-point scale. Two readers evaluated each scan.

**Results:** Of 123 patients recruited, exercise ECG testing was positive in 72%. Hypoperfusion was inducible on MPS in 74%, but only 20% had extensive inducible hypoperfusion (affected >10% of myocardium). On follow-up 6 months later, overall the SAQ physical limitation score had improved from 66 to 76 ($P<0.0001$). The mean exercise capacity increased from 7.2 METS to 9.0 METS ($P<0.0001$). The New York Heart Association functional class remained unchanged in 62%, improved in 33%, and worsened in 5%. Independent predictors of improvement were male gender, limiting chest pain on baseline exercise testing, and MPS summed difference score (SDS). These variables were all significant on univariate and multivariate analysis.

**Conclusions:** Most patients undergoing elective PCI had inducible ischemia on MPS of <10%. Patients who benefited most from PCI were men with limiting chest pain on exercise stress testing associated with inducible hypoperfusion on MPS.

**Reviewer's Comments:** Most patients demonstrated symptomatic and functional improvement after PCI. However, this study did not look at whether a matched group of patients on modern medical therapy would have had similar improvements. Rather, the results demonstrated that those most likely to show improvement after PCI were men with limiting chest pain with treadmill stress associated with inducible hypoperfusion on MPS. Would this same group have also shown a similar improvement 6 months later after medical therapy alone? (Reviewer-Thomas F. Heston, MD).

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Keywords: Myocardial Perfusion Imaging, Predicting PCI Outcomes

Print Tag: Refer to original journal article
On FDG-PET/CT, any uptake of FDG in the ovaries or uterus of postmenopausal women should be considered pathologic and potentially malignant.

**Background:** It is important to understand the normal FDG uptake pattern in the ovaries and uterus on PET when performing examinations in women.

**Objective:** To review the literature for normal and abnormal findings in these organs for both premenopausal and postmenopausal patients.

**Results:** In postmenopausal women, there should be no FDG uptake present in normal ovaries. For premenopausal women, focal FDG uptake may be seen in the ovaries (primarily unilaterally) between about the 10th and 25th days of the menstrual cycle. Often, it is believed that the focus of FDG activity corresponds to a corpus luteal cyst. To avoid normal physiologic uptake in the ovaries of premenopausal women, FDG-PET exams can be scheduled to be performed at the end of menstruation. The CT component of PET/CT can be used to aid in the distinction between FDG in local lymph nodes or adjacent small bowel and actual ovarian uptake. Analogous to the situation with ovarian FDG activity, the normal uterus in postmenopausal women should show minimal if any FDG activity. In premenopausal women, modest FDG uptake is often seen in the uterus at menstruation. Leiomyomas (uterine fibroids) typically show only mild FDG activity equal to or less than that in the liver. In addition, some data suggest that FDG uptake in these benign tumors diminishes with age. In contrast, FDG activity of malignant leiomyosarcomas or uterine carcinomas is generally intense.

**Conclusions:** Any FDG uptake in the ovaries or uterus in postmenopausal women should be considered pathologic and potentially malignant. In premenstrual women, it is important to know the timing of the menstrual cycle for proper interpretation of FDG activity in these organs.

**Reviewer's Comments:** Although some of the phraseology in the article is a little rough, it contains some nice image examples, which make this article worth your review. (Reviewer-David Bushnell, MD).

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Keywords: Ovaries & Uterus, FDG Uptake Patterns

Print Tag: Refer to original journal article
In selected patients with suspected cardiorenal disease, Tc-99m tetrofosmin renal scintigraphy has comparable results to Tc-99m DTPA, and the outcomes correlate well with serum creatinine and Doppler renal function studies.

**Background:** Cardiac and renal functioning are intimately related. Poor function in one often leads to decreased functioning in the other. Evaluating both at a single setting could lead to important cost savings. The simultaneous evaluation of both may be of benefit medically and socioeconomically.

**Objectives:** To determine the feasibility of Tc-99m tetrofosmin renal scintigraphy, performed in conjunction with myocardial perfusion imaging (MPI), to compare the results of Tc-99m tetrofosmin planar renal scintigraphy against Tc-99m DTPA renal scintigraphy, and to evaluate Tc-99m tetrofosmin renal scintigraphy performed in conjunction with adenosine stress with renal scintigraphy performed at rest.

**Design:** Prospective cohort study.

**Participants:** 30 patients referred for clinical reasons for myocardial gated SPECT imaging. Twenty-four patients had hypertension (renovascular hypertension, n=7), 7 had diabetes, and 6 had dilated cardiomyopathy.

**Methods:** Patients underwent gated SPECT stress-rest MPI. A 2-day, single isotope (Tc-99m tetrofosmin) protocol was utilized. A week later, 24 of the 30 patients also underwent standard dynamic planar Tc-99m DTPA renal scintigraphy. On rest imaging (n=30), each patient underwent dynamic and functional renal imaging after the injection of Tc-99m tetrofosmin. After this, planar 30-minute study, gated SPECT MPI was performed. A dose of approximately 10 mCi (370 MBq) of Tc-99m was utilized. On stress imaging (n=21), the dynamic renal scan was started at the third minute of adenosine infusion. Again, immediately after the renal scan, gated SPECT MPI was performed. The gated SPECT study consisted of 36 projections of 25 seconds each with 16 frames per cycle. Renal scintigraphy consisted of a first-pass phase dynamic study followed by a functional phase for a total scan duration of 30 minutes. The differential split function was determined as was time to peak activity.

**Results:** Visually, the images from Tc-99m tetrofosmin were of higher quality. Split renal function as determined by Tc-99m tetrofosmin was comparable to the values obtained by Tc-99m DTPA. Time to peak activity also was similar between the 2 agents. In the patients undergoing adenosine stress renal imaging, there was a significant decrease in the Tc-99m tetrofosmin uptake index consistent with decreased renal perfusion or function.

**Conclusions:** Tc-99m tetrofosmin scintigraphy is able to assess both cardiac and renal function after a single injection of the isotope.

**Reviewer’s Comments:** This is a timely study because it shows that cardiac and renal scintigraphy can both be performed after a single injection of Tc-99m tetrofosmin. It will be interesting to see if adenosine stress renal scintigraphy will be of benefit clinically. This likely has important socioeconomic value. (Reviewer-Thomas F. Heston, MD).

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Keywords: Cardiorenal Disease, Cardiorenal Scintigraphy

Print Tag: Refer to original journal article
This study provides proof of the concept that radioimmunotherapy can be used successfully to treat microscopic liver metastases in patients with colorectal cancer.

**Background:** Liver metastases will at some time develop in nearly 50% of all patients with colorectal cancer (CRC). Many patients with CRC have liver metastases at the time of diagnosis, even though the tumors are too small for detection by currently available imaging methodology. In theory, the role of adjuvant chemotherapy in stage II/III CRC patients is to eliminate these microscopic tumor foci. However, in practice, the effectiveness of adjuvant chemotherapy is limited. Radioimmunotherapy (RIT) may be a useful alternative or addition to chemotherapy in this setting.

**Objective:** To establish preclinical proof that RIT may be effective in the setting of microscopic metastatic CRC.

**Design:** MG1-DTPA antibody conjugates labeled with In-111 and Lu-177 were prepared. These antibody conjugates target a surface antigen on the CRC cell line used in this study. Adult rats were inoculated with CRC cells from this cell line through the portal vein for establishment of hepatic metastases. Lu-177 MG1 was administered to a group of rats at 4 hours after CRC cell inoculation in the liver and to a second group 14 days after cancer cell inoculation. In addition, Lu-177 labeled to a nonspecific IgG antibody was administered in the same radioactive dosages as the colorectal-specific Lu-177 MG1 to a 4-hour inoculation group and to a 14-day group. Kaplan-Meier survival curves were used to compare outcomes for the groups.

**Results:** Survival was significantly better for the rats treated with Lu-177 MG1 at 4 hours after liver inoculation (a time when metastatic sites would still be microscopic in size) than for all 3 of the other groups. In contrast, the 14-day group treated with Lu-177 MG1 did not show a survival advantage compared to the 14-day group treated with the Lu-177-labeled nonspecific antibody.

**Conclusions:** RIT may effectively treat microscopic liver metastases but does not appear to be effective in larger tumors. For CRC patients undergoing surgery who are at high risk for disease recurrence, clinical trials are needed to evaluate the effect of RIT.

**Reviewer's Comments:** We have already seen that Bexxar® and Zevalin® increase survival when given in an adjuvant setting for patients with follicular non-Hodgkin's lymphoma. I am becoming convinced that targeted radionuclide therapy used in an adjuvant setting has a bright future. (Reviewer-David Bushnell, MD).

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Keywords: Colorectal Cancer, Liver Metastases, Radioimmunotherapy

Print Tag: Refer to original journal article
An integrated PET/low-dose CT procedure is a promising screening technique for patients with pulmonary nodules who are at high risk for lung cancer.

**Background:** Routine screening by chest x-ray for patients at risk for lung cancer is ineffective. However, low-dose CT (ldCT) imaging might be a cost-effective method for this indication. Preliminary evidence indicates that ldCT can detect stage I disease in high-risk groups undergoing screening with this technique. The problem to date seems to be the high number of false-positive findings on ldCT, resulting in unnecessary invasive procedures.

**Objective:** To determine whether FDG-PET could improve the screening process by reducing the rate of false-positive results associated with using only ldCT.

**Participants:** Of 307 subjects with lung nodules who were referred for PET/ldCT, 93 fulfilled the criteria for having a high risk of lung cancer.

**Methods:** Data analysis was performed. PET images were interpreted independent of the features/characteristics of the nodule seen on ldCT. Findings on ldCT were also interpreted without knowledge of the PET results. All images were assessed by experienced observers. Establishment of malignant status for each nodule was based on histology, in most cases, or on imaging follow-up in some cases.

**Results:** The mean nodule diameter was 16 mm (range, 3-30 mm). Malignancy was diagnosed in 35 of the 93 patients. Based on visual PET image analysis, there were 33 true-positive and 2 false-negative findings (bronchoalveolar carcinoma, n=1; 5-mm carcinoid tumor, n=1). Based on ldCT, there were 34 true-positive and 1 false-negative results. There were 17 false-positive visual PET results compared to 30 false-positive results for ldCT. Overall visual PET assessment lead to a sensitivity of 94% and a specificity of 70% compared to 97% and 48%, respectively, for ldCT. Using an SUV$_{\text{max}}$ cutoff value of 2.2 improved the specificity for PET to 83%, but the sensitivity dropped to 77%.

**Conclusions:** For patients at high risk for lung cancer, an integrated FDG-PET/ldCT screening procedure may improve the evaluation and characterization of lung nodules. Using an SUV$_{\text{max}}$ cutoff value of 2.2, the FDG-avid lesions were associated with a significantly improved specificity, potentially decreasing the false-positive rate associated with stand-alone ldCT and avoiding further unnecessary invasive diagnostic and therapeutic procedures.

**Reviewer's Comments:** The added cost of incorporating PET into the screening procedure may be offset by the reduction in costs associated with fewer invasive procedures due to a reduction in false-positive results. (Reviewer-David Bushnell, MD).

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Keywords: Pulmonary Nodules, PET/CT, Assessing Cancer Risk

Print Tag: Refer to original journal article
For myocardial perfusion SPECT studies, a new 3D reconstruction algorithm, which includes spatial resolution recovery, can be used with half-time imaging without altering image quality or ventricular function results.

**Background:** Myocardial perfusion SPECT studies typically require ≥10 minutes of acquisition time. Advanced reconstruction algorithms, which include spatial resolution recovery, are being developed that can potentially cut the acquisition time in half.

**Objective:** To compare standard acquisition and reconstruction of myocardial perfusion SPECT versus a new 3D reconstruction method for studies acquired in half the normal imaging time.

**Methods:** This was a multicenter trial involving 11 institutions and 448 patients undergoing gated stress and rest myocardial perfusion imaging (MPI) with Tc-99m radiotracers. All studies were performed on Digirad® SPECT systems which had 1, 2, or 3 detectors. Resting studies were performed with 7 to 10 mCi of tracer, while the stress studies were performed with 20 to 30 mCi. The collection system allowed simultaneous collection of the image data for the standard acquisition time (approximately 10 minutes) and the half-time image data. The full-time data were reconstructed with the conventional 2D-OSEM algorithm, while the half-time data were reconstructed using a 3D iterative algorithm that had resolution recovery. The 2 data sets were randomized and evaluated by 3 expert nuclear cardiologists for image quality assessment.

**Results:** 40% of the studies were read as abnormal. The readers found that the quality of the half-time SPECT images was equivalent to or better than the quality of the standard SPECT images 98% of the time for both resting and stress studies. There was also 99% agreement in the image-based diagnosis with the 2 methods. The quantitative parameters were all strongly correlated with regression line slopes near 1 and correlation coefficients >0.98. No significant difference was found in the severity of the perfusion defects between the 2 methods.

**Conclusions:** The new 3D reconstruction algorithm can be used with half-time imaging without altering image quality or ventricular function results.

**Reviewer's Comments:** This is another result suggesting that advanced reconstruction algorithms that compensate for spatial resolution can be used to reduce imaging time or the amount of administered activity. A nice feature of this investigation was that the half-time and full-time acquisitions were acquired simultaneously, presumably by using list mode. It would have been interesting to include the half-time data reconstructed with the standard algorithm. I suspect that, in many cases, the smaller number of counts would not seriously affect the results regardless of the reconstruction method. However, there does appear to be value in the new resolution recovery algorithms, and their clinical use is likely to increase. (Reviewer-Mark T. Madsen, PhD).

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Keywords: Myocardial Perfusion SPECT, Acquisition Time vs Technique

Print Tag: Refer to original journal article
Myocardial perfusion prone-only imaging detects obstructive coronary artery disease (CAD) reasonably well and may be just as good at detecting obstructive CAD as is supine-only positioning.

**Background:** Supine myocardial perfusion imaging (MPI) comes with the potential for diaphragmatic attenuation of the inferior wall, which is either corrected using computer software or with prone imaging. Several studies have shown improvement of the specificity of MPI when the combined use of supine and post-stress prone is used.

**Objective:** To determine the ability of prone-only imaging to detect obstructive coronary artery disease (CAD), using cardiac catheterization (cath) as the gold standard.

**Design:** Retrospective study.

**Participants:** 386 patients referred for MPI, excluding those with prior myocardial infarction or revascularization procedures.

**Methods:** 246 patients underwent cardiac cath within 3 months of MPI, and the remaining 140 had a very low pre-test probability of having CAD. Stress and rest MPI were done in the prone position, using the 17-segment model for interpretation. The sensitivity and specificity for MPI compared to cath were calculated.

**Results:** Patients with abnormal MPI tended to be male, have diabetes and hypertension, have lower left ventricular ejection fractions, and have ischemic ECG changes. At cath, 35% of patients had normal studies or <50% stenosis, while 65% of patients had ≥50% stenosis (of this 65%, 85% had ≥70% stenosis). The sensitivity and specificity of prone-only imaging were 88% and 61%, respectively, for stenoses ≥50%, and were 92% and 55%, respectively, for stenoses ≥70%. Normalcy rates among the left anterior descending coronary artery (LAD), left circumflex coronary artery, and right coronary artery territories were 93%, 96%, and 95%, respectively (no statistically significant difference).

**Conclusion:** MPI prone-only imaging is reasonably good at detecting obstructive CAD.

**Reviewer's Comments:** The results of this intriguing and well-executed study show the efficacy of prone-only imaging in detecting obstructive CAD when compared to cardiac cath results. The results make us question whether supine imaging is even necessary. The authors suggest that prone-only imaging is just as good at detecting obstructive CAD as is supine-only positioning. However, studies directly comparing prone-only to supine-only and the combined supine-post-stress prone protocols are required to validate this conclusion. If prone-only imaging could supplant the combined supine/post-stress prone protocol, then the procedure could save time and enable more patients to be imaged. These results seem to refute concerns regarding the LAD territory artifact that may arise from prone-only imaging, giving the similar and high normalcy rates of all vascular territories. However, this, too, must be further confirmed with other studies, as prone-only imaging would trade one artifact for another. (Reviewer-Damita Thomas, MD).

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Keywords: Myocardial Perfusion Imaging, Imaging Position, Detecting CAD

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According to international experts, the appropriateness of cardiac CT for most indications has increased since the initial publication of the Appropriateness Criteria statement by the American College of Cardiology in 2006.

**Background:** In 2006, the American College of Cardiology, along with several other medical organizations, published the Appropriateness Criteria for cardiovascular CT covering 39 separate indications for the procedure. Since then, there has been rapid growth in both cardiac CT technology and clinical experience.

**Objective:** To reassess expert opinion regarding the appropriateness of cardiovascular CT.

**Design:** Cross-sectional survey.

**Participants:** 72 international experts in the field of cardiac CT, including 40 cardiologists and 32 radiologists.

**Methods:** Survey participants all independently rated, on a scale of 1 to 9, the 39 indications listed in the original 2006 Appropriateness Criteria statement. Indications were categorized as "appropriate" (score of 7 to 9), "uncertain" (4 to 6), or "inappropriate" (1 to 3). The median reader score was considered to represent current opinion for each indication. These results were compared with the original value in the 2006 document.

**Results:** Of 12 indications previously categorized as "uncertain," survey participants rated 5 as "appropriate." All previously categorized "appropriate" indications continued to remain "appropriate." Overall, 26 of the 39 indications showed increased appropriateness scores. There was no significant difference found between U.S. and non-U.S. participants or between cardiologists and radiologists.

**Conclusions:** Since the original 2006 Appropriateness Criteria statement was published in 2006, expert opinion regarding the appropriateness of cardiac CT has experienced a significant shift toward appropriateness across most indications.

**Reviewer's Comments:** It is not surprising that the published Appropriateness Criteria statement has not kept up with advances in cardiac CT technology and gains in clinical knowledge. The results of this report suggest that appropriateness criteria statements for all imaging procedures should be viewed as guidelines only and not as strict rules. (Reviewer-Thomas F. Heston, MD).

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Keywords: Cardiac CT, Appropriateness Criteria, Update

Print Tag: Refer to original journal article
Timing of F-18 FLT PET Imaging Critical

Kinetic Analysis of 3'-Deoxy-3'-18F-Fluorothymidine (18F-FLT) in Head and Neck Cancer Patients Before and Early After Initiation of Chemoradiation Therapy.

Menda Y, Boles Ponto LL, et al:


SUV\textsubscript{max} obtained at 45 to 60 minutes correlates with kinetic parameters both on initial and mid-therapy F-18 FLT PET/CT scans in patients with head and neck cancer.

**Background:** F-18 FLT PET/CT imaging is gaining more interest as an oncologic PET tracer because studies have demonstrated its use as a marker of cellular proliferation. However, there are no published reports on how FLT uptake changes in post-therapy head and neck cancer patients. Also, because SUV\textsubscript{max} is often used as a semiquantitative measure of tracer uptake, it is important to know if this measure correlates with the more objective kinetic analysis of FLT tracer as it moves in and out of tumor cells.

**Objective:** To demonstrate the change in kinetics of FLT in baseline and post-therapy head and neck patients, and to determine if SUV\textsubscript{max} values can act as a suitable surrogate in reflecting FLT uptake.

**Methods:** This prospective study evaluated 8 patients with proven stage III or IV head and neck cancer. All patients received a baseline F-18 FLT PET/CT and either radiation or chemoradiation therapy. All but 1 patient received a scan midway through the therapy regimen. Kinetic analysis of the tracer over time evaluating tracer influx and efflux as a surrogate measure of the phosphorylation process were measured on both baseline and mid-therapy scans. The SUV\textsubscript{max} of the tumor or metastases was also measured.

**Results:** Kinetics of FLT differed between pre- and mid-therapy scans, with pre-therapy scans showing a steady increase in activity that seemed to reach a plateau by 10 to 20 minutes and remaining steady thereafter. However, mid-therapy scans demonstrated a rapid increase of tracer uptake with a subsequent decline to a plateau reached by 45 to 60 minutes. Correlating SUV\textsubscript{max} with the kinetic analyses, the SUV\textsubscript{max} values were found to more closely reflect true FLT activity in mid-therapy scans when measured at 45 to 60 minutes.

**Conclusions:** FLT kinetics change in mid-therapy head and neck cancer patients when compared to baseline studies. As such, imaging should begin no earlier than 45 minutes, particularly in mid-therapy patients, to accurately reflect tracer activity and to achieve better correlation with SUV\textsubscript{max}.

**Reviewer's Comments:** The results of this interesting study show how FLT activity changes between pre- and mid-therapy scans by using kinetic modeling to demonstrate the flux of the radiotracer tumor tissue. The authors believe this change in flux reflects the diminished phosphorylative capacity of damaged/destroyed tumor cells. However, as the authors nicely demonstrated, if measured at different times, the SUV\textsubscript{max} may not accurately demonstrate the true FLT activity in tumor tissue. As FLT is increasingly being studied as a PET tracer, this becomes quite clinically relevant because knowing when to commence imaging becomes essential so that the comparison of pre- and post-therapy studies is reliable. (Reviewer-Damita Thomas, MD).

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Keywords: Head & Neck Cancer. F-18 FLT, Pre- & Post-Therapy Kinetics

Print Tag: Refer to original journal article
The addition of F-18 FDG-PET to conventional staging with CT/MRI can reduce the number of futile laparotomies in colorectal cancer patients being evaluated for surgical resection of liver metastases.

**Background:** When colorectal cancer (CRC) metastasizes, it does so primarily to the liver. Because patients with no evidence of extrahepatic disease are often surgically treated with curative intent, identifying patients who would most benefit from surgical resection of colorectal liver disease is of utmost importance. However, using the conventional staging methods of CT/MRI, up to 40% of patients have unresectable liver metastases at the time of surgery. In up to 50% of patients who undergo hepatic resection, extrahepatic disease develops within 1 year of surgery because the extrahepatic disease was not detected prior to hepatic resection.

**Objective:** To determine if the addition of F-18 FDG-PET to CT/MRI will reduce the number of unnecessary surgeries in CRC patients with colorectal liver metastases by identifying patients with more extensive liver or extrahepatic disease who would otherwise be deemed unresectable.

**Design:** Randomized, multicenter trial.

**Participants:** 150 patients with proven CRC (primary disease resected) with suspected liver metastases.

**Methods:** 75 patients underwent conventional staging with CT/MRI (controls), and 75 underwent conventional staging plus F-18 FDG-PET (test patients). All patients were followed up for at least 3 years for evidence of recurrence, with overall survival (OS) and disease-free survival (DFS) measured. No one received additional preoperative chemotherapy, just the initial regimen given after resection of the primary tumor. F-18 FDG-PET was performed within 3 weeks of surgery. SUV was not used for interpretation.

**Results:** Although the OS and DFS were not significantly different between the 2 groups, 45% (n=33) and 28% (n=20) of the control and test groups, respectively, underwent unneeded surgery.

**Conclusions:** Incorporating the use of FDG-PET into the clinical evaluation of CRC patients with liver metastases can reduce the number of futile laparotomies being performed.

**Reviewer's Comments:** This interesting study explores how FDG-PET can be useful in identifying CRC patients with liver metastases who would benefit from surgical resection of hepatic disease. The authors state that the absolute risk reduction of 17% means that 6 patients must undergo FDG-PET to avoid 1 unnecessary surgery. This seems to be a pretty good trade-off because PET is noninvasive with risks that are far less serious than surgery. The cost-effectiveness of this approach may be of added benefit because it is likely that the cost of surgical laparotomy and postoperative follow-up is much more expensive than an FDG-PET scan. Although OS/DFS were not different between the 2 groups, the study's results seem to demonstrate that the addition of FDG-PET in the evaluation of these patients can decrease the morbidity if unnecessary surgery is avoided. (Reviewer-Damita Thomas, MD).

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Keywords: Colorectal Cancer, Liver Metastases, FDG-PET

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Tracer Seen Simultaneously in Stomach, Ectopic Sites in MD

Detection of Ectopic Gastric Mucosa Using 99mTc Pertechnetate: Review of the Literature.

Kiratli PO, Aksoy T, et al:

Ann Nucl Med 2009; 23 (February): 97-105

Tc-99m pertechnetate imaging in combination with an H2 blocker is useful for detecting Meckel's diverticula in children.

Background: Most Meckel's diverticula (MD) that cause symptoms contain ectopic gastric mucosa. Consequently, imaging with Tc-99m pertechnetate (Tc-99m O4) will often detect these symptom-causing diverticula.

Objective: To evaluate the utility of this imaging technique for detecting ectopic gastric mucosa in MD.

Design/Participants: A retrospective analysis of 50 children referred for suspected MD.

Methods: Patients received 1 mCi (37 MBq) Tc-99m O4 along with 1mg/kg of ranitidine to block secretion of the pertechnetate from the gastric mucosa. SPECT imaging was not performed.

Results: Of the 50 subjects, 37 had normal-appearing images and 8 showed findings typical for MD (focal abdominal uptake simultaneous with activity seen in stomach). All 8 of these cases were surgically confirmed to represent MD. An additional 5 patients had uptake patterns atypical for MD and, in each case, surgery showed no evidence for MD. However, in 3 of these 5 cases, intestinal duplication cysts were found that harbored gastric mucosa. One patient with essentially no abnormal pattern also went to surgery, and no pathology was found.

Conclusions: The results of this study emphasize the value of Tc-99m O4 imaging in combination with an H2 blocker for detecting MD.

Reviewer's Comments: The authors' experience suggests the importance of using the standard image interpretation criteria of focal pertechnetate uptake seen simultaneously with uptake in the stomach for making a diagnosis of MD. Unfortunately, the authors did not provide information on eventual diagnosis or clinical follow-up of 36 of 37 patients with a normal pertechnetate exam. The authors provide a useful brief review of the literature pertaining to pertechnetate imaging for MD. I wonder if it would be a good idea to utilize SPECT CT imaging in children suspected of having asymptomatic MD. Finally, Tc-99m O4 imaging has also been used successfully in the past to detect ectopic gastric mucosa in adults with Barrett's esophagus. (Reviewer-David Bushnell, MD).

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Keywords: Meckel's Diverticula, Imaging Ectopic Gastric Mucosa

Print Tag: Refer to original journal article
Among thyroid cancer patients with residual disease, recombinant human thyroid stimulating hormone (rhTSH) improves the number of thyroid cancer lesions detected by PET but may not alter patient management.

**Objective:** To determine the incremental value of recombinant human thyroid stimulating hormone (rhTSH) administration before FDG PET scanning for the number of lesions detected and for management of thyroid cancer patients with residual disease and elevated serum thyroglobulin (Tg).

**Participants:** Patients were aged >18 years and had a history of papillary or follicular thyroid cancer previously treated by total thyroidectomy and radioiodine ablation, a Tg level ≥10 μg/L (withdrawal or stimulated), no abnormal foci by radioiodine scanning within 12 months of study, and ≤3 known or suspected extracervical metastases by conventional imaging. Exclusion criteria included the presence of Tg antibodies and known bone or cerebral metastases.

**Methods:** Patients underwent basal PET/CT scanning with T4 treatment followed by rhTSH-stimulated PET/CT scanning. Treatment planning was performed prospectively at 3 times: before basal PET/CT, after basal PET/CT, and after rhTSH-stimulated PET/CT. All images were reviewed separately by 2 readers who were blinded to clinical status and rhTSH administration.

**Results:** Follow-up was available for 63 patients. Five patients (8%) had false-positive scans (determined by cytology). Management was not altered in 5 additional patients with uncertain tumor status in FDG-avid foci. In the 35 patients without false-positives, there was no significant difference between basal PET and rhTSH PET for the number of patients in whom any disease was detected. Of the 108 true-positive lesions, 72 were identified on both scans, 30 on the rhTSH scans only, and 6 on the basal study only (P=0.005). For lesions detected on both scans, there was a significant increase in average SUVmax following rhTSH stimulation. Basal PET scans resulted in alteration of patient management in 19% of patients. True-positive lesions found by rhTSH PET/CT resulted in altered patient management in only 6% of patients (not statistically significant).

**Conclusions:** Administration of rhTSH prior to PET/CT results in a larger number of lesions detected but no significant difference in the number of patients in whom any disease is detected. The number of patients for whom therapy was altered by the inclusion of rhTSH administration was not significant in this study but may be in a larger study.

**Reviewer’s Comments:** A total of 8 patients had altered treatment as a result of findings following rhTSH administration. Four of these patients subsequently proved to have false-positive findings. (Reviewer-Shayne Squires, MD).

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Keywords: Thyroid Cancer, PET, Recombinant TSH, Incremental Value

Print Tag: Refer to original journal article
Hyperthyroid women who desire to become pregnant should be treated with radioactive iodine before pregnancy to avoid the risks of fetal birth defects linked to methimazole and to avoid liver injury to the mother linked to propylthiouracil.

Propylthiouracil (PTU) and methimazole (MMI) have been used for >50 years to control hyperthyroidism (HT). MMI is recognized as superior to PTU because adherence rates are higher and toxicity is less frequent than with PTU. MMI is currently the preferred medical treatment of Graves’ disease and for preparing a patient for radioiodine or surgery. In pregnancy, however, PTU is recommended because, on very rare occasions, birth defects have been associated with MMI. PTU is also tried in patients who had minor reactions to MMI and in cases of life-threatening thyroid storm because of its additional inhibition of T₄ and T₃ conversion. The current practice of using PTU as a first-line agent in pregnancy has been reevaluated at 2 recent society meetings. PTU-related liver failure has been reported in 33 adults and 14 in children. Between 1990 and 2007, 16 liver transplants in adults and 7 in children were reported due to PTU-induced liver failure. MMI is typically less permanently damaging to the liver, causing cholestatic dysfunction rather than parenchymal liver inflammation. By comparison, while 1 to 3 PTU-related liver transplants occurred per year, there were no liver transplants in the United States attributed to MMI toxicity. During the same time, 12 pediatric patients sustained severe liver injury resulting in 3 deaths and 6 liver transplants. Approximately 60,000 adults develop HT in the United States each year. PTU is prescribed to 25% of patients treated with antithyroid drugs. Data suggest that the risk of PTU-induced liver failure may be greater for children and that PTU-treated children are at low but significant risk of liver failure. Monitoring liver function tests in unlikely to prevent development of severe PTU-related liver damage. Drug-related hepatotoxicity can occur weeks to years after the use of PTU. PTU should be limited to circumstances when radioactive iodine treatment is not an option and the patient has developed a toxic reaction to MMI. Even surgery is to be preferred to PTU. Hyperthyroid women who desire to become pregnant should be treated with radioactive iodine or surgery before pregnancy. This avoids the risks of MMI-associated fetal birth defects and the similarly small but finite risk of PTU-related hepatotoxicity in the mother.

**Reviewer's Comments:** Since we are in the thyrotoxicosis-treating business, we must keep current with the competition. This editorial, while focusing on PTU, provides a succinct summary of practice standards in treating HT. Given the rare but severe complications of antithyroid drug therapy plus the several less severe but more frequent toxicities, I-131 seems a safer and more effective method of permanently eliminating HT. In the U.S., at least, it seems to be gaining popularity for use even in childbearing females and some children. (Reviewer-C. Richard Goldfarb, MD).

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Keywords: Hyperthyroidism, Propylthiouracil, Safety & Use Update

Print Tag: Refer to original journal article
PET with FDG in a hyperinsulinemic state promotes FDG uptake in viable myocardium, allowing detection of hibernating myocardium.

Myocardial PET-CT: Myocardial perfusion scintigraphy is most commonly a SPECT procedure, but PET may soon challenge SPECT's dominance. PET overcomes artifacts encountered in SPECT myocardial perfusion imaging due to diaphragm, chest wall, and breast attenuation. CT for attenuation correction of PET images requires less time than the transmission source used in stand-alone PET scanners, but it requires close attention to the fusion and raw images to avoid artifacts. CT also allows coronary calcium scoring (risk stratification) and CT angiography (anatomic evaluation). Like thallium, Rb-82 is a potassium analogue that has a better extraction fraction compared with 99mTc-labeled SPECT agents and, therefore, is less likely to result in false-negative studies for ischemia. Due to its short half-life (75 seconds), Rb-82 is used with pharmacological stress (dipyridamole or adenosine). In chronic coronary artery disease, there is both poor contractile function and poor perfusion despite viable cardiac tissue ("hibernating myocardium"), which is difficult to distinguish from myocardial infarct on SPECT. Both have poor perfusion at rest and stress imaging. PET with FDG in a hyperinsulinemic state promotes FDG uptake in viable myocardium. Resting Rb-82 images are acquired prior to FDG administration. Neurologic Uses: The grey matter uses glucose so that both increased and decreased metabolisms are used in evaluating suspected dementia, brain tumors, and epilepsy. In a recent multicenter study, FDG-PET was shown to be approximately 95% accurate in distinguishing Alzheimer's disease (AD) from frontotemporal dementia (FTD) and in distinguishing dementia with Lewy bodies (DLB) from normal patients. During PET-CT for oncologic applications, incidental identification of dementia patterns may be helpful. PET amyloid-specific imaging agents are currently being studied for the evaluation of dementia. For CNS neoplasms, FDG-PET is useful to evaluate the post-treatment brain for recurrence. Both radiation necrosis and recurrent tumor can have a similar appearance on contrast-enhanced MRI. FDG PET may guide follow-up or identify regions to target for biopsy. In intractable epilepsy, FDG PET has been shown to be more sensitive in identifying seizures originating in the temporal lobes. Reviewer's Comments: PET-CT use in oncology may soon max out if it has not done so already. Cardiac and neurological applications (the earliest PET applications) have yet to achieve clinical popularity. Now that PET-CT is widely available, expect to see more cardiac and brain PET studies, but not a whole lot more unless more solid data are forthcoming to demonstrate the advantage of PET/CT. Both cost and CT radiation concerns are formidable obstacles. And, in the case of neurologic applications, adding CT adds little anatomic benefit since most patients already have had MRIs. (Reviewer-C. Richard Goldfarb, MD).

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Keywords: PET-CT, Cardiovascular & Neurologic Applications

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In patients with known or suspected coronary artery disease, abnormal coronary flow reserve in the setting of normal perfusion images predicts an increased 3-year risk of cardiac events.

**Objective:** To assess the incremental prognostic value of coronary flow reserve (CFR) and the value of myocardial perfusion imaging (MPI) with 13N-ammonia PET MPI in patients with suspected or known coronary artery disease (CAD).

**Design:** Retrospective study.

**Participants:** 256 patients (150 with known CAD) who were referred for PET MPI.

**Methods:** Follow-up was available for 96% of patients (mean 5.5 years). Patients who underwent revascularization <60 days after PET were excluded. Patients were imaged using a standard 1-day protocol using adenosine as the stress agent and 13N-ammonia as the imaging agent. Perfusion images were evaluated by 2 experienced readers using the 17-segment model and semiquantitative scoring system recommended by the American Society of Nuclear Cardiology. Quantitative myocardial blood flow (MBF) was determined using institutionally developed software. CFR was calculated as the ratio of hyperemic to baseline MBF, and a ratio <2.0 was considered abnormal. End points were major adverse cardiac events (MACE) and cardiac death (CD).

**Results:** CFR was significantly lower in myocardial territories that appeared abnormal on perfusion images. In the following results, "CFR" refers to global CFR. Patients (n=71) with normal perfusion and normal CFR had 10-year MACE and CD rates of 14.1% and 5.6%, respectively. Abnormal perfusion images and abnormal CFR both independently predicted higher rates of MACE and CD. In the 56 patients with abnormal perfusion and normal CFR, the 10-year MACE and CD rates were 35.7% and 7.1% respectively. In the 70 patients with abnormal perfusion and abnormal CFR, 10-year MACE and CD rates were 55.7% and 25.7%, respectively. Abnormal CFR in the setting of normal perfusion images did not predict significantly higher 10-year event rates, but over a shorter 3-year period, it did predict higher MACE (6.25% vs 1.4% per year) and CD (3.1% vs 0.5% per year).

**Conclusions:** Using 13N-ammonia, MPI findings and CFR both strongly predict cardiac events. CFR adds prognostic value over MPI alone and predicts 3-year risk of cardiac events in patients with normal perfusion images.

**Reviewer's Comments:** Although 13N-ammonia is unavailable at many imaging centers, similar results might be obtained using 82Rb. Abnormal CFR may predict microvascular dysfunction in the setting of normal perfusion images. (Reviewer-Shayne Squires, MD).
Uptake of C-11 methionine is increased in recently infarcted myocardium, likely reflecting early healing and remodeling.

**Background**: The tissue uptake of C-11 methionine has been successfully used to evaluate amino acid metabolism primarily for the diagnosis of brain and other tumors. Methionine uptake reflects protein synthesis, amino acid transport, and transmethylation.

**Objective**: To evaluate the uptake of C-11 methionine in infarcted myocardium after successful reperfusion.

**Design**: Prospective cohort study.

**Participants**: 9 patients with acute myocardial infarction (MI) of the anterior or anteroseptal wall who underwent successful revascularization by percutaneous transluminal coronary artery intervention within 24 hours of the infarction.

**Methods**: All patients underwent rest-only Tl-201 SPECT within 7 days of their MI. Within 2 weeks of the MI, F-18 FDG-PET imaging after a glucose load was done, as was C-11 methionine PET. Standardized uptake values of the infarcted myocardium and normal peri-infarct regions were determined.

**Results**: F-18 FDG images showed decreased tracer uptake in the infarction region. Thallium-201 SPECT images also showed decreased tracer uptake by the infarcted myocardium. However, C-11 methionine images showed increased tracer uptake in the infarction area. The highest accumulation of C-11 methionine was observed in the early post-infarction time.

**Conclusions**: Recently infarcted myocardium shows decreased uptake of F-18 FDG and Thallium-201, but it also shows increased uptake of C-11 methionine. The increased tracer uptake of C-11 methionine may reflect early remodeling after infarction.

**Reviewer's Comments**: The healing process after MI goes from myocardial cell death, to acute inflammation, to the formation of granulation tissue, and finally to scar formation. C-11 methionine uptake occurs during acute inflammation and the formation of granulation tissue. (Reviewer-Thomas F. Heston, MD).

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Keywords: Myocardial Infarction, Reperfusion, C-11 Methionine Uptake

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