



## New PET NSCLC Clinical Trial

The American College of Radiology Imaging Network (ACRIN) announced in March the opening of a new clinical trial titled, “Fluorodeoxyglucose (FDG) as a Predictive Marker of Tumor Response and Patient Outcome: Prospective Validation in Non-Small Cell Lung Cancer” (ACRIN 6678). The trial is designed to determine whether PET can effectively and consistently measure quantitative changes in <sup>18</sup>F-FDG uptake during chemotherapy and thereby provide early indicators and predictors of the effectiveness of therapy in patients with advanced non-small cell lung cancer (NSCLC).

Under principal investigator Wolfgang Weber, MD, of the University of California at Los Angeles Medical Center, this will be one of the first clinical trials initiated by the Oncology Biomarker Qualification Initiative (OBQI), a new and innovative collaboration between the National Cancer Institute, Food and Drug Administration, and Centers for Medicare & Medicaid Services. The OBQI initiative will work to provide data to qualify biomarkers for use in clinical trials and ultimately speed new drug therapies to clinical application. Some OBQI projects, including this trial, will be funded through public-private partnerships coordinated under the Foundation for the National Institutes of Health (NIH) and executed through the auspices of the NIH Biomarker Consortium. More than 10 sites throughout the United States are expected to enroll 228 patients in ACRIN 6678 over a 2-year period. To view the entire protocol, summary, and supplementary data, visit [www.acrin.org/6678\\_protocol.html](http://www.acrin.org/6678_protocol.html). Questions about participation can be directed to protocol manager Donna Hartfeil at [dhartfeil@phila.acr.org](mailto:dhartfeil@phila.acr.org).

American College of Radiology  
Imaging Network

# Review of Current PET/CT Instrumentation and Software

By Jeffrey T. Yap, PhD

The 2007 SNM Annual Meeting, June 2–6 in Washington, DC, will demonstrate advances in combined PET/CT scanners that narrow the gap between the features that are available on combined-modality systems versus single-modality CT or PET scanners. All three PET/CT vendors will showcase their most advanced clinical PET/CT scanners with 64-slice CT configurations. In addition to matching the escalation of CT detector slices, improvements have been made in PET instrumentation and software that will enable the clinical realization of advanced technology that has been limited to research settings.

While early clinical PET/CT scanners and software were primarily focused on oncology, this year major advances have been made in the area of cardiology. Likewise, neurology is an emerging area of focus spurred by the clinical reimbursement of Alzheimer’s disease. All three vendors have addressed this on the software side with packages to assist in the identification and assessment of neuro-degenerative diseases. Philips provides NeuroQ and Siemens provides Scenium, both of which are based on the work of Daniel Silverman, MD, PhD, at the University of California, Los Angeles. GE Healthcare has recently released Cortex ID, which is based on the work of Dr. Satoshi Minoshima, MD, PhD, at the University of Washington (Seattle).

GE has improved upon the existing Discovery STE PET/CT scanner with the addition of the 64-slice LightSpeed VCT scanner. The Discovery VCT provides 40 mm of axial coverage in CT, which expands the potential for cardiac imaging as well as respiratory gating. The SnapShot Pulse technology combines step-and-shoot acquisitions with prospective gating to achieve reductions in patient dose while maintaining image quality. The Discovery Dimension acquisition and processing console features the unique ability to perform whole-body respiratory-gated acquisitions during a standard clinical PET/CT protocol. The VUE Point reconstruction software is available on the Dimension console and has been improved by including corrections for random coincidences in the iteration loop.

GE introduced a new suite of cardiac PET/CT applications at the 2006 RSNA meeting. CardIQ Fusion allows coronary CT angiography to be fused with PET perfusion maps. CardIQ Physio allows processing of gated and dynamic PET data and export to external analysis software. ACQC (Attenuation Correction Quality Control) addresses

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the issue of image registration errors to due to cardiac movement by allowing reconstructed cardiac PET and CT images to be manually re-registered, saved as a new CT image series, and then used for attenuation correction.

At the 2007 SNM meeting, GE will introduce PET VCAR (Volume Computer Assisted Reading) software that performs lesion segmentation and automated reporting of tumor size and SUV quantification for the evaluation of response to cancer therapy. GE will also announce a suite of products for Motion-Free PET/CT that include MotionView 4D for performing respiratory gated PET/CT on a routine basis and MotionCorrect, which allows a time-averaged CT cine acquisition to be used for attenuation correction in order to minimize attenuation artifacts due to organ motion.

The Siemens Biograph PET/CT features a fast LSO scintillator, high spatial resolution using the HI-REZ detector block (4 x 4 x 20 mm elements), and fast Pico3D electronics. Siemens launched the Biograph TruePoint PET/CT at the SNM meeting last year and built on the existing platform by increasing the axial coverage of PET detectors by 1/3. The extended axial field-of-view system, known as TrueV, increases the count rate of a single bed position and also provides greater anatomical coverage. The combination of higher count rates and fewer bed positions translates into the ability to perform whole-body oncology studies with improved image quality or to maintain image quality and perform the PET exam with less radiation to the patient or in a shorter period of time. TrueC is the model-based scatter correction, which has been enhanced by incorporating the correction in an iterative loop. Siemens will introduce new software for improving spacial resolution and contrast ratio at the 2007 SNM meeting.

TrueD is the primary application in the Siemens Oncology Engine and allows qualitative and quantitative comparison of two PET/CT exams from different time-points that are automatically coregistered. Recent improvements to TrueD include performance enhancements in volume-of-interest (VOI) quantification, additional support for MRI and SPECT/CT, visualization of gated CT and PET images, and support for saving VOIs as DICOM Structure Set Objects that can be easily incorporated into radiation therapy planning (RTP) systems.

The Biograph TruePoint is now available in combination with the 64-slice Sensation CT scanner, which extends the capabilities of cardiac imaging. Siemens will demonstrate new software at the 2007 SNM meeting to address some of the challenges of cardiac PET/CT imaging. A metal artifact reduction algorithm has been implemented to address the attenuation artifacts created by pacemaker leads. Siemens will also introduce software for correcting errors in attenuation correction due to cardiac motion misregistration. On the application side, syngo Circulation software has been enhanced to support PET/CT data and allow coronary arteries imaged with CT to be visualized with PET perfusion images.

Although Philips was the last major vendor to enter the PET/CT marketplace, their systems have introduced unique features such as the OpenView gantry design that improves patient access during scanning and may reduce the incidence of claustrophobia. Philips will showcase the Gemini TruFlight PET/CT scanner—which encompasses improvements in the use of LYSO as a scintillator material, high-resolution PIXELAR detector design (4 x 4 x 22

mm elements), high-performance photomultiplier tubes, faster acquisition electronics with 100 picosecond timing resolution, and advanced reconstruction algorithms. These result in improved overall scanner performance and image quality for all patients using the standard 3D RAMLA LOR reconstruction algorithm while also enabling time-of-flight (ToF) reconstructions. The realization of the concept of time-of-flight has been an attractive yet elusive goal since the early development of PET. The current Gemini TruFlight achieves a coincident timing resolution of 650 picoseconds that results in a positioning accuracy of 10 cm. The combination of advances in hardware and ToF reconstruction software allow image quality to be improved, particularly in larger patients. The increased computation demands associated with 3D reconstruction of ToF list-mode data have been addressed with a high-performance computer platform consisting of 10 Intel Xeon 3 GHz dual-core processors. This allows a typical whole-body ToF reconstruction to be completed around 10 minutes after the acquisition of the final PET bed position.

Since the introduction of the 16-slice Gemini TF at the 2006 SNM meeting, more than 60 systems have been installed, and a model using the 64-slice Brilliance CT scanner is now available. Recent developments include the addition of PET respiratory gating and a Gemini TF model that is field upgradeable to ToF. On the software application side, Philips provides the Syntegra for multi-modality image registration and clinical review as well as the Emory Toolbox for cardiac applications.

A continuing theme for PET/CT imaging is the expanded access to multi-modality images and related advanced software beyond the PET/CT imaging workstation that is typically purchased with the PET/CT scanner. The ability to send PET and CT DICOM images to external computers such as PACS and RTP workstations has been well established for several years. However, these remote systems have typically lacked the functionality to fully utilize coregistered PET and CT images. PET/CT application software is now available on PACS workstations such as the GE AW Suite available on Centricity PACS. Siemens and Philips provide access to their applications on PACS through a third-party vendor, Thinking Systems. In the specific area of radiation therapy, all three vendors offer radiation therapy simulation packages that incorporate coregistered PET and CT images. Siemens offers COHERENCE VSim on the syngo Multi-Modality Workplace, while GE offers SIM MD on the Advantage Workstation and Philips offers Tumor LOC on the Extended Brilliance Workspace.

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Letters to the editor of the *PCOE Newsletter* are welcome and may be published in future issues. Send your comments to [PCOEnewsletter@snm.org](mailto:PCOEnewsletter@snm.org).

## Views You Can Use



Fig. 1

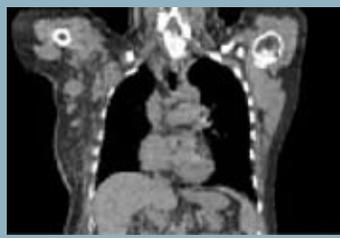


Fig. 2

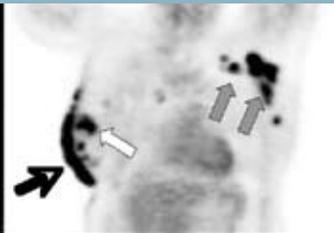
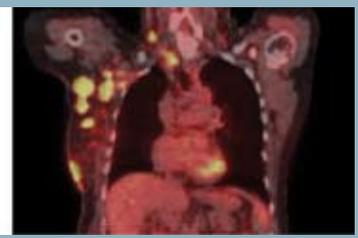
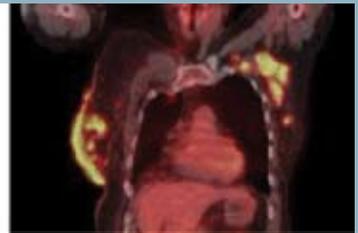


Fig. 3



### PET/CT Case: Breast Cancer

This 54-year-old woman with biopsy-proven, infiltrating ductal carcinoma of the right breast was found to have bilateral axillary adenopathy on a staging CT scan. A diagnostic mammogram and ultrasound examination of the left breast showed that the enlarged lymph nodes had an appearance suspicious for malignant nodes, and the left breast showed diffuse skin and trabecular thickening thought to represent lymphatic engorgement. Neither the mammogram or breast sonogram showed any masses, architectural distortion, or microcalcifications suspicious for a left breast malignancy.

A staging PET/CT scan showed extensive increased FDG uptake in the skin of the right breast (black arrows), in the right breast parenchyma (white arrow), in bilateral axillary lymph nodes (gray arrows), and in several right neck foci (arrowheads), corresponding to anatomic abnormalities on the CT images (Figs. 1–3).

### How Did PET/CT Imaging Help?

PET/CT demonstrated the extensive nature of the cancer, with skin involvement in most of the right breast and marked adenopathy in both axillae and in the right neck. Supraclavicular and contralateral axillary metastases are uncommon but have been reported in the literature (1,2,3). This route of metastatic spread should be kept in mind when contralateral axillary adenopathy is seen without evidence of any contralateral breast primary tumor. ■

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2. *J Surg Oncol*. 2004;86(3):167–9.
3. *Bull Cancer*. 1998;85(8):713–5.

### About Views You Can Use

This case was provided by David Seldin, MD, Franklin Square Hospital Center, Baltimore, MD. It was also featured on the Web site of Gabriel Soudry, MD, at [www.petcases.com](http://www.petcases.com). In addition to the Web site, Dr. Soudry also mails printed versions of his example cases to referring physicians in Franklin Square and the surrounding community. Working with Dr. Soudry and other PET specialists, the PCOE Web site ([www.snm.org/PET](http://www.snm.org/PET)) features “Views You Can Use,” single-sheet PDFs that include specific cases, images, and references. As a PCOE member, you can add your own contact information to these sheets and distribute them electronically or by printed hard copy to referring physicians for educational purposes.

# PET in the Literature



The international literature on PET and PET/CT continues to grow at a pace that challenges both researchers and clinicians. In each issue, the *PCOE Newsletter* presents a tomographic slice of the breadth of PET literature that appears in publications around the world. Weekly lists of all published PET research are available to logged-in members in the PET Center of Excellence Web area at [www.snm.org/pet](http://www.snm.org/pet) in the PET References Archive under Resources. Articles selected for relevance to clinical oncologists are also featured weekly under PET News.

## Cardiology

Avid FDG Uptake in the Right Ventricle Coupled with Enhanced Intercostal Muscle Hypermetabolism in Pneumoconiosis.

([http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list\\_uids=17452877](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=17452877))

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Radionuclide reporter gene imaging for cardiac gene therapy.

(17464505)

Inubushi M, Tamaki N.

*Eur J Nucl Med Mol Imaging.* 2007; E-pub Apr 27.

## General Clinical Practice

Potential role of FDG PET in the setting of diabetic neuro-osteoarthropathy: can it differentiate uncomplicated Charcot's Neuroarthropathy from osteomyelitis and soft-tissue infection?

(17460537)

Basu S, Chryssikos T, Houseni M, et al.

*Nucl Med Commun.* 2007;28:465–472.

Bone regeneration 6 years after impaction bone grafting: A PET analysis.

(17464607)

Ullmark G, Sorensen J, Langstrom B, et al.

*Acta Orthop.* 2007;78:201–205.

## Instrumentation and Data

High-density materials do not always induce artifacts on PET/CT:

What is responsible for the difference? (17460541)

Kaneta T, Takanami K, Wakayama Y, et al.

*Nucl Med Commun.* 2007;28:495–499.

Two-dimensional vs three-dimensional imaging in whole body oncologic positron emission tomography/computed tomography: a Discovery-STE phantom and patient study.

(17464266)

Bettinardi V, Mancosu P, Danna M, et al.

*Q J Nucl Med Mol Imaging.* 2007; E-pub Apr 30.

## Molecular Imaging

In vivo mouse imaging and spectroscopy in drug discovery.

(17451175)

Beckmann N, Kneuer R, Gremlich HU, et al.

*NMR Biomed.* 2007;20:154–185.

Bystander Killing of Malignant Glioma by Bone Marrow-derived Tumor-Infiltrating Progenitor Cells Expressing a Suicide Gene.

(17457322)

Miletic H, Fischer Y, Litwak S, et al.

*Mol Imaging Ther.* 2007; E-pub Apr 24.

## Neurology

Topographic brain mapping of the international cooperative ataxia rating scale: A positron emission tomography study.

(17450320)

Wang PS, Liu RS, Yang BH, et al.

*J Neuro.* 2007; E-pub Apr 21.

Using a reference tissue model with spatial constraint to quantify [(11)C]Pittsburgh compound B PET for early diagnosis of Alzheimer's disease.

(17449282)

Zhou Y, Resnick SM, Ye W, et al.

*Neuroimage.* 2007; E-pub Mar 16.

## Oncology

Early therapeutic response assessment by (18)FDG-positron emission tomography during chemotherapy in patients with diffuse large B-cell lymphoma: Isolated residual positivity involving bone is not usually a predictor of subsequent treatment failure.

(17454604)

Ng AP, Wirth A, Seymour JF, et al.

*Leuk Lymphoma.* 2007;48:596–600.

Functional diagnosis of residual lymphomas after radiochemotherapy with positron emission tomography comparing FDG- and FLT-PET.

(17454633)

Kasper B, Egerer G, Gronkowski M, et al.

*Leuk Lymphoma.* 2007;48:746–753.

## Radiopharmacology

Radiolabeling of multimeric neurotensin (8-13) analogs with the short-lived positron emitter fluorine-18.

(17451963)

Hultsch C, Berndt M, Bergmann R, et al.

*Appl Radiat Isot.* 2007; E-pub Mar 6.

Synthesis, Characterization and In Vivo Studies of Cu(II)-64-Labeled Cross-Bridged Tetraazamacrocyclic-amide Complexes as Models of Peptide Conjugate Imaging Agents.

(17458949)

Sprague JE, Peng Y, Fiamengo AL, et al.

*J Med Chem.* 2007; E-pub Apr 26.

## Clinical Oncology Practice Guidelines Available from NCCN

The National Comprehensive Cancer Network (NCCN) Web site offers an online library of clinical practice guidelines in oncology that covers 97% of tumors encountered in oncology practice. The guidelines were developed as decision pathways that outline care management with discussions of important issues at each step. References are provided to demonstrate the basis for care recommendations.

Guidelines are offered for treatment of cancers by site, for supportive care, and for detection, prevention, and risk reduction. The guidelines were developed and are continuously reviewed by professional panels from NCCN member institutions.

You can download the guidelines at <http://www.nccn.org>.



### FDG-PET Imaging Clearly Predicts Lung Cancer Patients' Response to Chemotherapy

Released: May 8, 2007

#### Repeating Molecular Imaging Studies Provides Valuable Information for Better Patient Care, Say Researchers in May *Journal of Nuclear Medicine*

RESTON, VA—An earlier indication of whether chemotherapy benefits non-small cell lung cancer patients—provided by positron emission tomography (PET) imaging—can guide doctors in offering them better care, according to researchers in the May *Journal of Nuclear Medicine*.

“Our study demonstrates that patients who respond to chemotherapy can be identified early in the course of their treatment, and these patients will generally exhibit prolonged overall survival,” explained Claude Nahmias, professor of radiology and medicine at the University of Tennessee Medical Center in Knoxville. “Although we studied a relatively small number of patients—and our results should be interpreted with caution—it is clear that a repeat PET study with the radiotracer fluorodeoxyglucose (FDG) at the end of the first cycle of chemotherapy would allow the identification of those patients for whom the therapy was futile.” ...

“With non-small cell lung cancer—since the relatively modest increase in survival must be balanced against the toxicity of the chemotherapeutic treatment—the case for monitoring therapeutic response is especially compelling,” said Nahmias. “To assess the response to chemotherapy in patients with advanced non-small cell lung cancer, all of the studies published thus far have evaluated the patients at one, or at most two, time points after the initiation of chemotherapy. In our study, we evaluated 15 patients weekly—for seven weeks—as they started their chemotherapy regimen. In spite of the persuasive findings of several studies investigating PET for monitoring response to cancer therapy, until now no published reports have clearly demonstrated that PET results were used to alter treatment.” ...

## pet center of excellence newsletter

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