

UVRA Radiologists

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 J. Daniel Rasband, MD
 Kimball B. Taylor, MD
 Gary M. Watts, MD
 John D. Wendel, MD
 S. Douglas Wing, MD, FACR

For questions,
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 please contact Utah
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 Associates:

801.357.7056

24/7 Consultation

PET/CT in Clinical Practice

Positron Emission Tomography (PET) has been available in the US for around 3 decades. However, availability was initially limited to a few, select research centers widely spaced across the country. Early PET imaging was limited by high costs (due to the very specialized equipment necessary), long imaging times (patient motion significantly degrades images), and lack of specificity (areas of abnormal activity could not be very well localized).

Seven years ago, PET imaging was revolutionized by replacing the standard method of attenuation correction (correcting the image based on density of various tissues) with conventional CT. This effectively cut the time required for imaging in half, while at the same time, significantly increasing specificity through the use of co-registered PET and CT images. Thus the modern era of PET/CT was born.

Since the first introduction of PET/CT, use of this modality has skyrocketed. It seems that on a daily basis, a new application of the modality is reported in the literature. New tracers (radioactive molecules targeted to specific disease processes or tissues) are beginning to filter through clinical trials, making extremely sensitive and specific imaging available for numerous different disorders.

With mainstream radiotracer availability limited to fluorine-18 labeled deoxyglucose (FDG), PET/CT

imaging is mainly used for detecting disease processes in which the use of glucose as an energy substrate is altered. Fortunately, many common malignancies are hypermetabolic, thus taking up asymmetrically increased amounts of FDG, and thereby detectable on PET/CT images. Imaging for inflammatory conditions and dementia/seizures are other indications in which glucose metabolism is altered.

The imaging process consists of intravenously administering a diagnostic dose of the radiotracer followed by adequate time for the tracer to distribute throughout the body. It is important that the patients rest quietly without stimulation to allow proper distribution (recent exercise, meals, insulin administration, and diabetes can all adversely affect distribution). The patient is then placed on the scanner and a CT is performed (90 seconds) followed immediately by the PET scan (24+ minutes). The images are then processed together providing both the CT and PET information, as well as fused images combining the two data sets. (See Figure 1)

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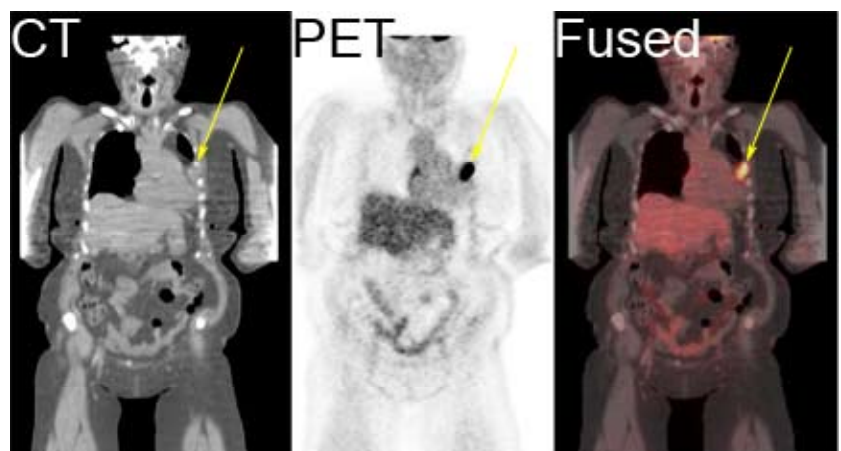


Figure 1: Coronal images showing the individual and combined data sets of CT, PET, and PET/CT with hypermetabolic neoplasm indicated by the arrow.



Figure 2: PET and fused images demonstrating a hypermetabolic nodule in the pelvis. The fused image demonstrates localization to the distal colon, actually representing a second primary malignancy in a patient with other metastatic disease in the chest.

PET/CT in Clinical Practice

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Current Applications:

The most common use for FDG PET/CT is in oncology. PET is very sensitive for the hypermetabolic tumor tissue, with resolution approaching 5 mm (depending on equipment). When combined with the CT data, it becomes possible to combine the excellent spatial resolution and anatomic detail with the physiologic information provided on the PET images.

PET/CT is very good at detecting multiple body sites of tumor growth, including very small nodules or widely disseminated disease. This has significant application in staging tumors. When used for staging purposes, research has shown PET/CT to alter management in 40-60% of cases. This has tremendous impact on patient care, often preventing unnecessary surgery. (See Figure 2)

PET/CT is very good at evaluating response to therapy, both after completion as well as during therapy. If there is no significant response to early rounds of therapy based on PET/CT findings, it is possible to make early changes to the treatment

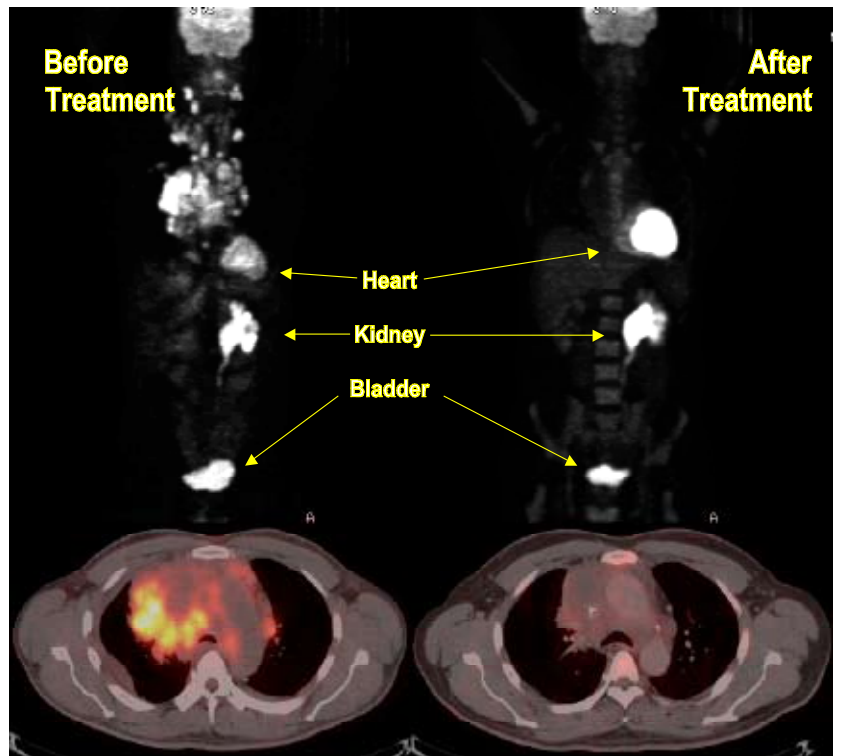


Figure 3: PET and fused images in a lymphoma demonstrating a dramatic response to therapy. Note that although the mass in the mediastinum remains, it is no longer hypermetabolic.

regimen for better results. Likewise, at the completion of therapy, a PET/CT scan can accurately gauge the response and indicate whether or not continued therapy is necessary.

As a monitoring study, PET/CT excels at detecting early recurrence, often long before a patient is symptomatic. Not only does a positive scan assist in further treatment planning, a negative scan provides tremendous relief and reassurance to patients about their current tumor-free status. (See Figure 3,4,5)

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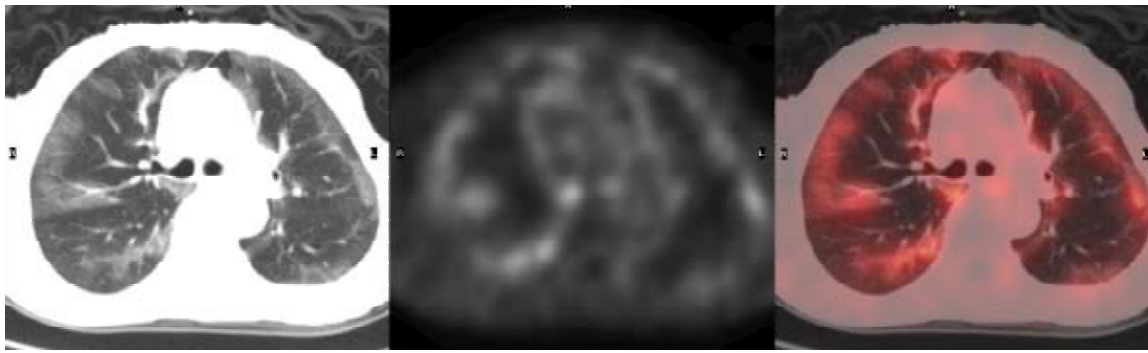


Figure 4: CT, PET, and PET/CT images showing that activity in the chest actually localizes to ground glass opacities in the lungs, consistent with pulmonary toxicity from chemotherapeutic drugs.

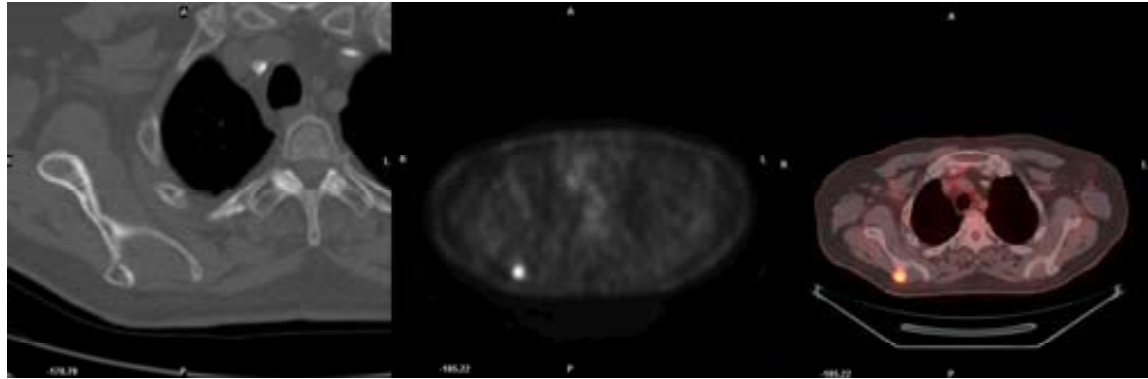


Figure 5: CT, PET, and PET/CT images demonstrate a right scapular metastasis not visible on CT imaging alone.

Future Applications:

PET/CT usage has been validated for use in many oncologic applications. Medicare has approved imaging of nine different tumor types, including breast, cervical, colorectal, esophageal, head & neck, non-small-cell lung, thyroid, lymphoma, and melanoma. Imaging is also approved for the characterization of solitary pulmonary nodules.

Just over two months ago, an initial report of a nationwide study was published in the Journal of Clinical Oncology documenting the impact PET has on treatment of non-Medicare-approved cancers. With data from over 28,000 studies, PET imaging prompted a “major” change in management in 30-40% of patients. Similar numbers have long been reported for the approved indications.

Imaging of inflammation is gaining support and evidence, including applications in evaluating atherosclerotic plaques, particularly in identifying high-risk plaques in various arterial beds including the coronary arteries. (See Figure 6)

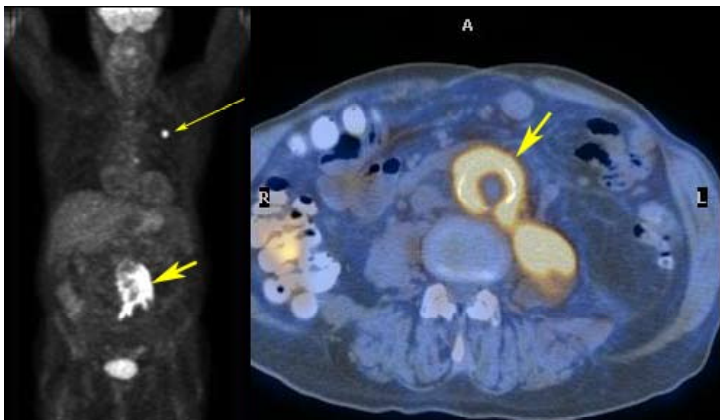


Figure 6: PET and PET/CT images demonstrate an infected aortic stent-graft with infection extending into the right psoas muscle.

These applications will likely remain the mainstay of PET/CT imaging for quite some time. As mentioned earlier, however, it seems that new applications are being introduced almost daily. These often entail novel radiotracers specially developed to image very specific disease processes. This is often based on specific genetic or protein features expressed by the disease. This is the new field of molecular based imaging, which when teamed with targeted drug therapy, will introduce a whole new approach to the diagnosis and management of disease. (See Figure 7)

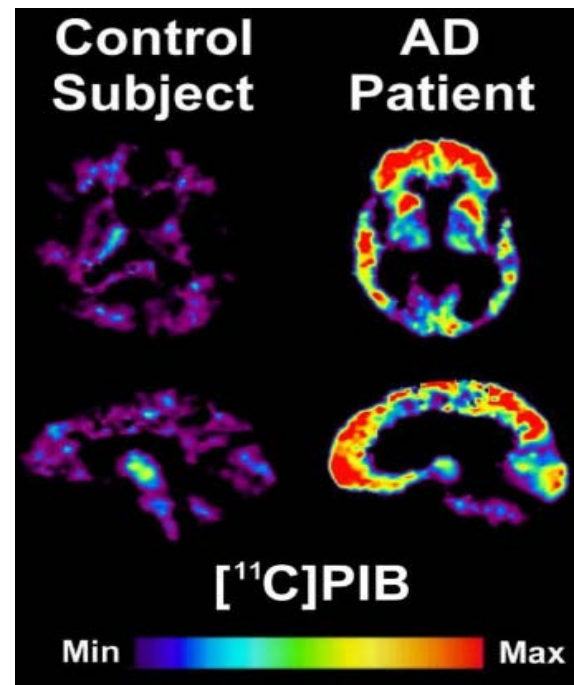


Figure 7: PET images in a patient with Alzheimer's dementia, utilizing carbon-11-labeled Pittsburgh Compound B.

Featured Physicians of Utah Valley Radiology Associates



Jeffery S. McClellan, MD

Dr. Jeffrey S. McClellan is fellowship-trained and board certified in diagnostic radiology. Dr. McClellan is skilled in interpreting and acquiring medical imaging using such clinical imaging techniques as magnetic resonance imaging (MRI), fluoroscopy, positron emission tomography (PET), projection radiography (x-ray), computed tomography, ultrasound, and other imaging tools. He has special interest in mammography, MRI, and ultrasound imaging techniques.

After graduating from medical school at the University of Utah School of Medicine, Dr. McClellan completed a transitional internship at the LDS Hospital in Salt Lake City. His residency and fellowship training in diagnostic radiology, including one year as chief resident, was completed at the Duke University Medical Center in Durham, North Carolina. Dr. McClellan has acted as the Chairmen of the Department of Radiology at Utah Valley Regional Medical Center (UVRMC). His professional associations include the Radiological Society of North America, the American College of Radiology, and the American Roentgen Ray Society.



Gary M. Watts, MD

Dr. Gary M. Watts is a diagnostic radiologist with over 30 years of experience at Utah Valley Regional Medical Center in Provo, Utah. He specializes in nuclear medicine including the diagnosis and treatment of thyroid disorders.

Dr. Watts is fellowship trained and board certified from the American College of Radiology Board, the American Board of Nuclear Medicine, the Primary Utah Board, and the Primary California Board.

After graduating from the University of Utah College of Medicine, Dr. Watts completed a straight medical internship, followed by a diagnostic radiology residency and a fellowship in nuclear medicine at Harbor General Hospital in Torrance, California. His professional associations include both state and national memberships: the Radiological Society of North America, the American College of Radiology, the Society of Nuclear Medicine, and the American Medical Association; the Utah State Radiology Society, the Utah State Medical Association, and the Utah County Medical Association.

Utah Valley Imaging/Pain Celebrate First Year Open

August 20th marked the one year anniversary of the opening of Utah Valley Imaging (UVI). The staff of UVI would like to take this opportunity to thank the community for its tremendous support over the past year and to re-affirm our commitment to provide unparalleled service to our patients and referring physicians.

UVI offers high quality MRI imaging with an open air design that significantly improves the imaging experience for most patients. UVI is staffed by 25 board-certified radiologists trained at the nation's leading medical institutions. Their areas of subspecialty expertise include interventional radiology, neuroradiology, musculoskeletal radiology, MRI, cross-sectional imaging (including computed tomography and ultrasound), nuclear medicine, PET, mammography, and pediatric radiology. UVI is also supported by two outstanding vascular surgeons.

Last October, UVI joined with Utah Valley Pain Management (UVPM) in order to provide comprehensive pain management services—including epidural steroid injections, radiofrequency nerve ablation, vertebroplasties, spinal cord stimulator placement, electromyography, nerve conduction studies, and physical therapy. The director of UVPM is Dr. Robin Ockey, who is board certified by the American Board of Physical Medicine and Rehabilitation with subspecialty certification in Pain Medicine. He is also board certified by the American Board of Electrodiagnostic Medicine and the by the American Board of Pain Medicine.

Utah Valley Imaging (801) 802-XRAY(9729) is located at 458 W. 800 N. in Orem Utah (one block East of Timpanogos Regional Hospital). Utah Valley Pain Management(801) 235-PAIN(7246) is located immediately behind UVI.