

PET/CT

Fusing Views for More Targeted Medicine

Courtesy of Siemens



From the invention of the X-ray in 1895 to the plethora of medical imaging technologies available today, many of the advances of modern medicine stem from our ability to see inside the human body. A dual-purpose imaging device, PET/CT provides the next leap forward in medical imaging by offering researchers and physicians alike the ability to view the body in two different ways at once.

PET/CT is literally the combination of PET (positron emission tomography) and CT (computed tomography) imaging techniques within a single scanner. The individual scans, which are taken virtually simultaneously, can be presented separately or as a single, overlapping, or “fused” image. The two techniques present different types of information about the human body: *PET shows metabolic or chemical activity in the body; CT shows the body’s anatomical structures.* For example, a PET scan would highlight a tumor’s increased glucose consumption, while a CT scan would reveal its physical mass.

PET/CT & Research

Richard M. Gewanter, MD, *Clinical Instructor of Radiation Oncology* at Columbia University College of Physicians & Surgeons, is conducting a clinical trial to investigate the benefits of PET/CT for targeted, dose-escalated radiation therapy in individuals with unresectable (inoperable), non-small cell lung cancer that has not spread beyond the lungs. Currently, such patients typically receive radiotherapy, chemotherapy, or a combination of both approaches. Those with locally advanced disease have a five-year survival rate of 10-20%. Using PET/CT to visualize tumors, Dr. Gewanter hopes to better tailor the radiation field while increasing the dosage level within that field—thereby improving survival rates.

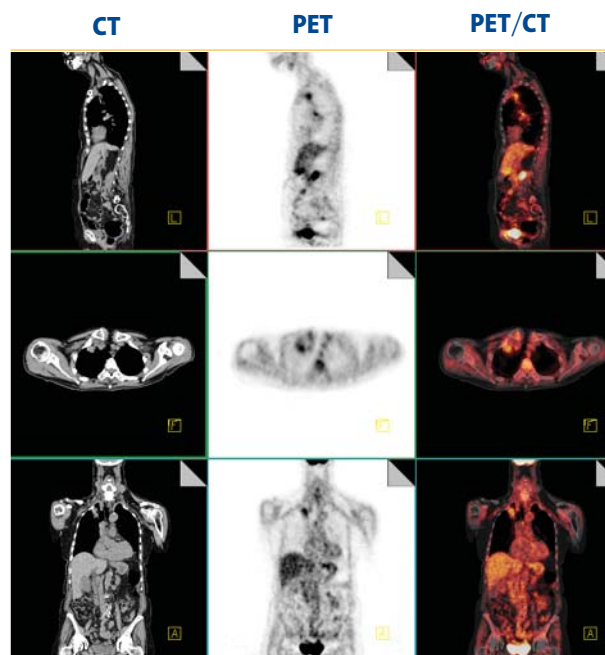
“The success of radiation therapy relies on knowing exactly where the tumor is in 3D space within the body and its relationship to the surrounding structures of the body,” explains Dr. Gewanter. “Traditionally, treatment planning for

The CT image (top) shows a mass in the right lung. The combined PET/CT image (bottom) reveals the metabolic activity of that mass, as well as its precise location in the lung. The fused image can help physicians with diagnosing and staging the disease, as well as tailoring the treatment plan.

these patients has been based on CT alone. In many cases, CT is limited in its ability to tell us the exact dimensions of the tumor and which parts of an abnormality are biologically active. PET, on the other hand, has the advantage of giving us the information we need about biological activity, but it lacks the necessary image resolution and spatial information. Combining the best of both modalities into one image should optimize our ability to deliver treatments.”

Individuals who enroll in Dr. Gewanter’s clinical trial will receive an initial, or baseline, PET/CT scan and a follow-up scan partway through treatment. Physicians will use the follow-up scan to monitor the patient’s response to the radiation therapy and to determine whether to adjust the radiation field or boost the dosage within that field. The goal is to increase the effectiveness of the therapy on the tumor site, while reducing the damage to surrounding healthy tissue. Dr. Gewanter plans to enroll around 10 participants in the pilot study and will expand the study population if initial results prove favorable. Eligibility requirements include:

- Non small-cell carcinoma of the lung, unresectable & locally advanced



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- Good performance status for tolerating aggressive radiation therapy, including adequate pulmonary function
- No prior radiation therapy and a limit of one previous cycle of chemotherapy

“With respect to clinical cancer imaging research, PET/CT is the state of the art,” says **Philip O. Alderson, MD**, *James Picker Professor of Radiology and Chairman of the Department of Radiology*. “It is the modality being used on virtually all the NIH/NCI (National Institutes of Health/National Cancer Institute) imaging protocols across the country to evaluate cancer staging and restaging.”


PET/CT & Clinical Care

In addition to its research applications, PET/CT can improve clinical care. Taking the two scans virtually simultaneously ensures that the patient remains in place and, therefore, that the two images form a precise computer overlay—that the tumor “hot spot” on the PET scan corresponds directly to the physical mass on the CT scan. It also eliminates the common problem of a delay between the two studies, during which time the patient’s condition may change. A study from Germany, presented at the 2003 meeting of the Radiological Society of North America (RSNA), reported that PET/CT fusion images made a critical diagnostic difference in approximately 20% of cases. In the study, radiologists reviewed the same cases—first using a traditional side-by-side visual comparison of PET and CT images, and then with the additional option of a fused, PET/CT image.

According to **Ronald L. Van Heertum, MD**, *Professor of Radiology and Director, Columbia Kreitchman PET Center*,

“PET/CT should be the baseline of diagnostic care for many oncology patients since it has the potential to substantially impact treatment plans. PET/CT is estimated to change up to 45% of treatment plans for radiation oncology, by either increasing or decreasing the suggested radiation field. That has enormous significance because the better you can target the field, the better you can reach all the cancer cells while avoiding damage to the surrounding healthy tissue. It plays a similar role for surgeons by helping to pinpoint exactly where to perform a biopsy or surgical excision.”

PET/CT fusion imaging is most valuable for cancers located in regions of the body that have a complicated anatomy, such as the neck and lower pelvis. These areas of the body contain organs, tissue, muscles, bones, lymph nodes, air, fluids, etc., all in close proximity—making the precise overlay of PET and CT particularly helpful. Similarly, PET/CT can aid in multifocal diseases, such as lymphoma, by providing more exact locations for biopsies and surgery.

PET/CT may herald a new direction for diagnostic imaging. “Currently, the concept of PET/CT is unique because it’s the first type of commercially available dual scanner,” says Dr. Alderson. “In fact, I think that PET/CT is just the first of a number of dual image scanners to come. In the future, MRI probably will be combined with PET and also with new technologies such as optical imaging—enabling even greater advances in research and clinical care.” 

For more information about the PET/CT non-small cell lung cancer trial (IRB# AAAA1625), please contact Dr. Gewanter at 212-305-5841.



The PET image (above) shows increased metabolic activity in the body through darkened “hot” spots. When PET is combined with CT, (above top), that metabolic activity is placed in the context of the anatomy. The hot areas at the bottom of the image correspond with the natural physiologic activity of the bladder and the right kidney, while a suspicious mass is revealed in the patient’s left lung.

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