

Molecular Imaging & Cancer

What is molecular imaging and how does it help people with cancer?

Molecular imaging is a type of medical imaging that provides detailed pictures of what is happening inside the body at the molecular and cellular level. Where other diagnostic imaging procedures – such as x-rays, computed tomography (CT) and ultrasound – predominately offer anatomical pictures, molecular imaging allows physicians to see how the body is functioning and to measure its chemical and biological processes.

Molecular imaging offers unique insights into the human body that enable physicians to personalize patient care. As a tool for evaluating and managing the care of patients, molecular imaging studies help physicians:

- Determine the extent or severity of the disease, including whether it has spread elsewhere in the body
- Select the most effective therapy based on the unique biologic characteristics of the patient and the molecular properties of a tumor or other disease
- Determine a patient's response to specific drugs
- Accurately assess the effectiveness of a treatment regimen
- Adapt treatment plans quickly in response to changes in cellular activity
- Assess disease progression
- Identify recurrence of disease and help manage ongoing care.

Advantages of molecular imaging for cancer patients:

- By detecting whether lesions are benign or malignant, PET scans may eliminate the need for surgical biopsy or identify the optimal biopsy location.
- PET scans help physicians choose the most appropriate treatment plan and assess whether chemotherapy or other treatments are working as intended.
- Information provided by PET imaging often eliminates the need for exploratory surgery or other invasive medical procedures.
- Information provided by molecular imaging technologies has the potential to help the drug development and approval process become faster, more effective and less expensive.
- PET scans are current the most effective means of detecting a recurrence of cancer.

SNM's Mission: To improve health care by advancing molecular imaging and therapy.

SNM Highlights

Advocacy

- Advocated on Capitol Hill for reliable domestic production source of Molybdenum-99 (MO-99) and the SNM's view on recent efforts to curtail the use of highly enriched uranium in radionuclide production.
- Continued efforts with the Alliance for Quality Medical Imaging and Radiation Therapy to support the Consistency, Accuracy, Responsibility and Excellence in Medical Imaging and Radiation Therapy (CARE) legislation.
- Worked with the AMA Physician's Consortium to develop and educate members on the radionuclide bone imaging physician quality measures in the 2009 Physician Quality Reporting Initiative (PQRI).
- Worked with a broad coalition of imaging stakeholders to develop comments for the Center for Medicare and Medicaid Services on the oncologic PET National Coverage Determination (NCD).
- Conducted successful annual Capitol Hill Days for SNM members to discuss with federal legislators the importance of molecular imaging research, quality, access and reimbursement.
- Oversaw activities of the Ambulatory Payment Classification (APC) Task Force, the molecular imaging and therapy community's leading coalition on coding and reimbursement issues.
- Created and hosted a 90-minute Webinar on FDG-PET where over 1,000 nuclear medicine professionals learned critical aspects of the new Medicare coverage and billing policies for oncologic indications.

Education and Research

- Promoted maintenance of certification and practice quality improvement for all professionals.
- Offered CT training for physician and technologist members.
- Recommended more cutting-edge molecular imaging components (e.g., new tracers and optical imaging techniques) for the nuclear medicine residency requirements while offering a more comprehensive optional advanced residency curriculum.
- Developing a molecular imaging curriculum for scientists to serve as a core curriculum that can be used as a guideline for graduate-level programs.
- Promoted and disseminated valuable new research on molecular imaging and other issues through SNM's high-quality journals and other publications.
- Launched the SNM Clinical Trials Network to accelerate clinical trials for investigational therapeutics and to increase the number of imaging biomarkers available for clinical use.
- Collaborated with American Society for Therapeutic Radiology and Oncology (ASTRO), the American Society for Clinical Oncology (ASCO) and the National Institutes of Health (NIH) on various symposia.

Resources

- PET PROS (professional references and outreach resources) created for referring and interpreting physicians to ensure easy access to important information and useful resources, including guideline summaries, a comprehensive reporting template and a payer relations kit.
- Launched a website (www.molecularimaging.org) which contains a wide variety of resources and information on all molecular imaging modalities for patients, referring physicians and professionals.

Radionuclide Ventriculography to Evaluate Left Ventricular Function Before and After Chemotherapy

66 year old man with prostate cancer before and after 10 cycles of mitoxantrone. Chemotherapy was changed to docetaxel due to drop in LV ejection fraction

Lymphoscintigraphy for Identification of Sentinel Lymph Nodes

49 year old man with melanoma of the scalp. Lymphoscintigraphy using SPECT/CT shows a right posterior auricular sentinel lymph node (arrow). An intraoperative gamma probe was used to identify and excise the node, which was benign.

Bone Scan for Identification of Skeletal Metastases

66 year old man with prostate cancer and new back pain. Bone scan shows widespread metastatic disease responsible for pain (arrows)

FDG PET/CT for Identification of Metastases

Same 66 year old man with prostate cancer. PET/CT shows widespread metastatic disease including lung (blue arrow) and bone (red arrow) lesions

Radioiodine for Thyroid Cancer

60 year old man post thyroidectomy for papillary thyroid cancer. Diagnostic scan with I-123 shows residual thyroid tissue in the neck and metastatic disease in the pelvis (red arrow). SPECT/CT shows the metastasis in the right iliac bone (yellow arrow). Scan done after I-131 200 mCi treatment dose shows radioiodine uptake in the neck and right iliac bone (blue arrow).

Radioactive Microsphere Therapy for Metastatic Disease to the Liver

SPECT/CT scan following injection of Y-90 microspheres shows radioactivity delivered to the large tumor in the dome of the liver (thick arrow) plus second smaller tumor (thin arrow)

▲ Tc-99m sulfur colloid diagnostic scan shows filling defect due to tumor in the right lobe of the liver (arrow)

Radioimmunotherapy for Lymphoma

Pre-treatment FDG PET scan showing relapsed lymphoma

Post-treatment FDG PET scan showing no lymphoma

Y-90 ibritumomab tiuxetan CD20 radiotherapeutic antibody

Palliation of Painful Skeletal Metastases

74 year old man with hormone refractory prostate cancer, who has continued pain despite chemotherapy and external beam XRT

The patient received Sm-153 Lexidroman for palliation of widespread skeletal metastasis

Treatment scan showing Sm-153 uptake in skeletal metastases

New Radiopharmaceuticals

F18 fluorothymidine (FLT) is a marker of tumor cell proliferation. Arrows show FLT uptake in rectal cancer.

New Radiopharmaceuticals

F-18 fluoromisonidazole (FMISO) is a marker of tumor hypoxia. Arrows show FMISO uptake in nasopharyngeal carcinoma that is not seen with FDG

FDG PET/CT

FMISO PET/CT