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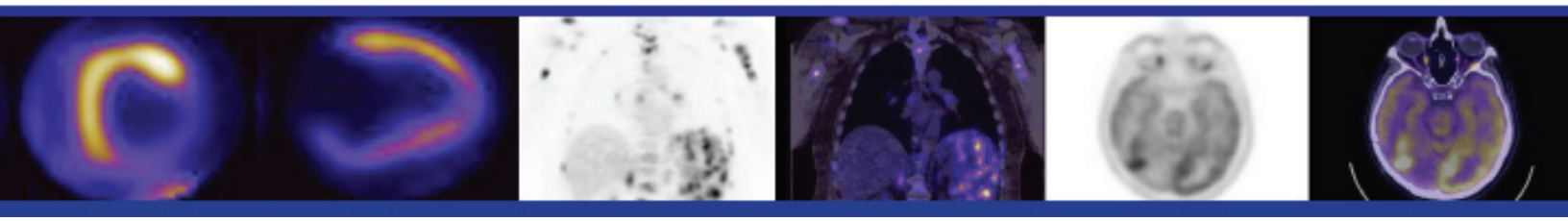

Molecular Imaging and Lung Cancer: Get the Facts

About Lung Cancer

Lung cancer is the leading cause of cancer death in the United States. Every year, approximately 215,020 patients are newly diagnosed with lung cancer, and it is estimated that more than 161,000 people die from lung cancer each year.

While the five-year survival rate of lung cancer patients is only about 14 percent, survival rates can improve significantly for those whose cancer is caught early and treated with surgery or other treatments. Fortunately, new developments in molecular imaging (MI) technologies are greatly advancing the detection, diagnosis and treatment of lung cancer.

What are molecular imaging procedures, and how can they help lung cancer patients?

Molecular imaging (MI) is a highly effective, safe and painless imaging and treatment tool that provides physicians with a detailed view of what is going on inside an individual's body at the cellular level. Most nuclear medicine procedures are molecular imaging procedures using radioactive substances.

The most commonly used molecular imaging procedure for diagnosing or guiding treatment of lung cancer is positron emission tomography (PET) scanning, which is often used in conjunction with computed tomography (CT) scanning. The National Oncologic PET Registry (NOPR)—a nationwide database documenting the use of PET and PET/CT in managing cancer—shows that in more than one out of three cases, PET/CT scan results prompt changes in a patient's treatment. The results, published in The Journal of Clinical Oncology, demonstrate the vital role that PET/CT can play to properly diagnose or verify the suspected recurrence. (For more information on PET/CT scanning, please see PET Scans: Get the Facts.)

In addition, the National Comprehensive Cancer Network (NCCN) has incorporated FDG PET/CT in the practice guidelines and management algorithm of most malignancies, including lung cancer [1, 2]. The guidelines of the American College of Chest Physicians also recommend the use of PET/CT in the evaluation of patients with lung cancer .[3]

What types of MI technologies are currently available for lung cancer patients?

Lung cancers fall into two different types:

1) A large percentage of lung cancers—about 80 percent—are **non-small cell lung cancers (NSCLC)**, which are triggered by smoking or other factors such as exposure to radon or asbestos. Accurately determining whether NSCLC has spread is critical in determining treatment options for patients. If NSCLC is diagnosed early enough, lung surgery can be a viable option. NSCLC can also be treated with chemotherapy and radiation.

PET/CT scans are used routinely to:

- Detect lung cancer and locate the most appropriate site for biopsy
- Establish how advanced the cancer is and whether it has spread to other parts of the body
- Help physicians and patients decide on courses of treatment that are tailored to patients' individual conditions and needs
- Determine whether medical treatments are working as intended
- Detect whether the disease has recurred after treatments are completed and assist physicians in determining a site that is appropriate for biopsy, if necessary

2) **Small cell lung cancers (SCLC)** are the most aggressive form of lung cancer and constitute approximately 20 percent of lung cancer cases. Smoking is almost always the cause of these cancers, and lung surgery is often not an option because the cancer is generally found in both lungs. Recent data strongly support the use of PET/CT for SCLC staging as limited versus extensive. PET/CT helps to guide the treatment, which usually consists of chemotherapy and/or radiation.

How does PET/CT work?

PET scanning is a molecular imaging procedure that allows physicians to obtain three-dimensional images of what is happening in a patient's body at the molecular and cellular level. For a PET scan, a patient is injected with a very small amount of a radiotracer such as fluorodeoxyglucose (FDG), which contains both a sugar and a radioactive element. The radiotracer travels through the body and is absorbed by tumors or cancer cells. The patient then lies down on an examining table and is moved to the center of a PET/CT scanner. The PET/CT scanner contains a PET scanner and a CT scanner next to each other. The CT scan and the PET scan are obtained one after the other. The PET scanner is composed of an array of detectors that receive signals emitted by the radiotracer. Using these signals, the PET scanner detects the amount of metabolic activity while a computer reassembles the signals into images. (For more information on PET/CT scans and how they work, visit PET/CT Scanning: Get the Facts.)

How does PET/CT help detect and diagnose lung cancer?

Lung masses are usually first evaluated by a chest x-ray or a CT scan. These tests can pinpoint the size and location of lung lesions, but cannot usually be used to determine whether the lesion is benign or cancerous. PET scans, however, are able to determine whether a mass is cancerous with high accuracy and can guide biopsy to the most suspicious and easily accessible lesions.

How does PET/CT determine whether the cancer has spread?

The outlook for a patient's recovery and treatment options depend on selecting treatments that are appropriate to the stage of the lung cancer. If lung cancer is found and treated with surgery before it has spread to lymph nodes or other organs, survival rates can be greatly improved. PET/CT scans are significantly more accurate than CT alone or any other test in determining whether lung cancer has spread to the lymph nodes or other parts of the body. PET/CT can also provide an alternative to biopsy (see below).

Can PET/CT help patients avoid unnecessary biopsy surgery?

In the past, patients with lung cancer had to undergo a surgical procedure called mediastinoscopy to collect tissue for biopsy. Mediastinoscopy is often done to check lymph nodes in the chest before considering lung surgery and other treatment options. However, mediastinoscopy requires general anesthesia and poses some risk of serious injury to vital structures in the neck and chest. PET/CT scans can provide a reasonable, noninvasive alternative to this surgery for determining the stage of lung cancer. In addition, traditional mediastinoscopy procedures only sample a few of the patient's lymph nodes. PET/CT scans can detect whether cancer has spread to critical lymph nodes that the surgical procedure cannot sample. Surgical biopsy is still required if PET/CT does reveal cancer in the mediastinal lymph nodes, and PET/CT can guide the surgical biopsy to the lymph nodes that are likely to have cancer cells, but it can be avoided if a PET/CT scan is negative.

How PET/CT scans assist patients and physicians as they decide on treatment options?

Patients with lung cancer have limited options for treatment based on both the type of cancer cells and the stage of the cancer. PET/CT scanning are critical tools for helping to determine which patients are good candidates for surgery or other treatments. If tests show that the cancer has not spread too far, then surgery can be performed to remove the cancer. If tests show that the cancer has spread too far, lung surgery will not eliminate the cancer completely. PET/CT detects spread earlier than other tests and decreases the number of unnecessary surgeries by 50% .[4] Along with surgery, chemotherapy and/or radiation therapy may also be recommended.

Can PET/CT be used to estimate a patient's prognosis?

Research indicates a correlation between the amount of FDG radiotracer absorbed by the cancer cells and a patient's chances for survival. Patients whose lung cancer absorbs less FDG have a greater survival rate. These results may also help physicians determine a patient's chances of survival following lung cancer surgery. PET/CT may even help identify patients at the highest risk for recurrence and death after treatment.

How can PET/CT assess whether treatments are working?

PET/CT is the most accurate tool available for determining whether cancer treatments are killing cancer cells, if cells are spreading to other parts of the body and whether cancer is recurring after surgery or other treatments are completed. For example, PET/CT scans in a study of patients with NSCLC who received chemotherapy indicated decreased activity in cancer cells after just one cycle of treatment.

How long does it take to get PET/CT results?

A trained radiologist or nuclear medicine physician will interpret the results and write a report for the physician who ordered the tests. A verbal report is available the day of the PET/CT, and the written report is usually delivered to the physician within two or three days.

Will insurance reimburse for PET/CT?

Medicare and insurance companies will cover the cost of most PET/CT scans. Because of the mounting evidence of the effectiveness of PET/CT scanning for the diagnosis and treatment of a wide range of cancers, coverage levels continue to expand. For the most updated information, check with your insurance carrier or physician.

Are there any new developments in MI on the horizon that could help lung cancer patients?

While smoking is still the greatest risk factor for developing lung cancer, researchers are making exciting advances in understanding the molecular and genetic mechanisms that play a role in how lung cancer develops. Promising areas of research include the development of novel reporter-gene imaging systems, which involves engineering genes that can adhere to cells and be tracked with molecular imaging technologies. In addition, scientists are working on ways to image molecular markers and biological pathways that provide insight into how lung disease progresses, as well as assess whether other therapies are working.

Where can I get more information?

To learn more about PET/CT scanning and other nuclear medicine and molecular imaging procedures, visit the SNM Molecular Imaging Center of Excellence and SNM PET Center of Excellence.

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