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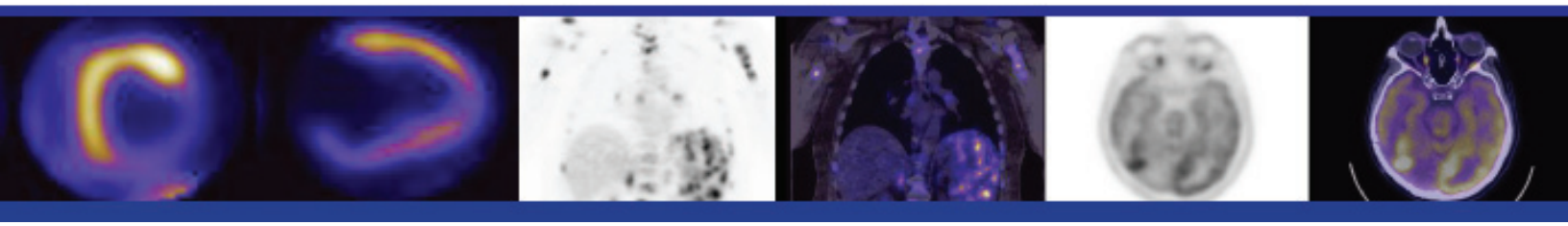

Molecular Imaging and Prostate Cancer: Get the Facts

About Prostate Cancer

Every year, approximately 186,320 patients are newly diagnosed with prostate cancer, and it is estimated that more than 28,000 people die from the disease each year. Prostate cancer is the most common cancer among men and the second leading cause of cancer-related deaths in men. However, prostate cancer is often not lethal, especially when the disease is accurately detected, diagnosed and monitored, and appropriate treatments are chosen. New advances in molecular imaging technologies have the potential to significantly advance the ways that prostate cancer is diagnosed and treated and greatly improve the quality of life for many prostate cancer patients.

What is molecular imaging, and how can it help patients with prostate cancer?

Molecular imaging (MI) is a highly effective, safe and painless imaging tool for accurately diagnosing and treating prostate cancer. For men diagnosed with prostate cancer, a number of treatment options exist, with differing side effects, and the choice can be difficult to make. Molecular imaging tools can greatly improve the accuracy of prostate cancer diagnoses and also provide detailed information about the cancer that can allow men to choose the best treatment options with more confidence.

Specifically, molecular imaging is a powerful, noninvasive tool for:

- Determining the extent of prostate cancer and whether it has spread to the lymph nodes or other parts of the body. Traditional imaging technologies, such as magnetic resonance imaging (MRI) and computed tomography (CT), are often unable to detect prostate cancer cells that have spread to soft tissue in other parts of the body.
- Helping assess how aggressive the prostate cancer is and what types of treatment are most appropriate.
- Pinpointing the most appropriate sites in the body for radiation therapy.
- Monitoring the effectiveness of medical treatments.

What types of MI technologies are used to help prostate cancer patients?

The most accurate imaging test available to determine whether prostate cancer has spread is the ProstaScint scan, which is used to detect prostate cancer cells in the body. Identifying the stage of the cancer—the extent to which it has spread to other parts of the body—is critical in helping patients and physicians choose a course of treatment. ProstaScint can also be used to determine the exact location of the cancer for surgical purposes, determine whether treatments are working and identify recurrence of prostate cancer in patients who have been treated.

The most commonly used molecular imaging procedure for diagnosing or guiding treatment of cancers is positron emission tomography (PET) scanning, which is often used in conjunction with CT scanning. PET/CT is generally not used to image prostate cancer, but some physicians have found PET/CT imaging useful in identifying fast-growing, aggressive tumors. In addition, PET/CT can be used in place of bone scans to painlessly determine whether prostate cancer has spread to the bone, a common occurrence. (For more information, please see PET Scans: Get the Facts.)

How does PET/CT scanning 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.
Another radiotracer called F18 sodium fluoride is used for the detection of the disease's spread to the bone. Fluoride contains the same radioactive

element as FDG but is absorbed by the bone where there is active bone formation due to cancer. (For more information on PET/CT scans and how they work, visit PET/CT Scanning: Get the Facts.)

How do physicians and patients make decisions about treating prostate cancer?

In evaluating a patient's prostate cancer and treatment options, physicians consider factors such as the patient's levels of prostate-specific antigen (PSA)—a protein produced by the prostate that often is elevated if there is prostate cancer—and the type of tumor the patient has. Tumors are evaluated according to the Gleason scale, which ranks tumors on factors such as the types of cells and their appearance. However, determining whether the prostate cancer has spread to the lymph nodes or other parts of the body is critical for making accurate decisions on whether and how to treat prostate cancer. Prostate cancer treatment options include surgery to remove the prostate, chemotherapy and radiation. Some older patients might also opt for a wait-and-see approach to slow-growing prostate cancers, which often do not spread for years. Some treatment options carry significant side effects that can affect patients' quality of life, such as impotence and incontinence. In addition, surgery is not effective in treating prostate cancer if it has already spread to the lymph nodes or other parts of the body. These three factors—the extent of the cancer in the body, the patient's PSA levels, and the types of tumors—are the strongest predictors of how a prostate cancer patient will respond to treatment.

How does ProstaScint work?

ProstaScint is an antibody that targets an antigen—known as Prostate Specific Membrane Antigen (PSMA)—produced by prostate cancer cells. Before ProstaScint is injected, it is combined with Indium In111, a radioactive substance that can be imaged. When the combination of ProstaScint and Indium is injected into a patient's bloodstream, the antibody attaches itself to the PSMA on cancer cells. The patient can then be scanned with a gamma camera to image the areas that have large amounts of the antibody.

How is ProstaScint scan administered?

The radioactive antibody is administered intravenously through an injection or intravenous drip. The patient may be given a preparation to cleanse his bowel prior to the scan. The imaging session will last about one hour. The patient will lie without moving his lower body while the camera rotates around him.

Is ProstaScint a good tool for determining whether cancer has recurred after treatment?

If a patient's PSA begins to rise following surgery to remove the prostate, it is an indication that the prostate cancer has recurred. A ProstaScint scan can show whether the recurrence is contained within the prostate bed or is in the lymph nodes. Such information is critical in helping physicians and patients decide how to treat the recurrence. Although studies have not yet been conducted to specifically evaluate the use of ProstaScint to determine whether there is a recurrence of prostate cancer after radiation or other treatments, there is no indication that these treatments would prevent ProstaScint from working correctly. Physicians need to understand how radiation therapy may affect the pelvic structures in order to best interpret the scans following radiation therapy.

Can ProstaScint be used for improving radiation treatment for prostate cancer?

Physicians are experimenting with combining ProstaScint data with information from CT imaging to allow for targeted radiation therapy. Using this information, physicians could deliver higher doses of radiation to tumors while at the same time sparing healthy tissue from unneeded treatment. In one study performed on 43 patients at the Mayo Clinic, the average levels of PSA, which indicates the presence of prostate cancer, decreased from 6.9 during treatment to 1.9 a month after the targeted therapy. In addition, only one patient suffered incontinence, which dissipated a month after the treatment ended. More studies are needed to determine the long-term effects of the targeted radiation.

Will insurance reimburse for MI tests for prostate cancer?

Medicare covers ProstaScint scans for prostate cancer patients. However, PET/CT scans are not covered. 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 prostate cancer patients?

There are several areas of research that could eventually lead to improvements in detecting, diagnosing and treating prostate cancer. They include:

- Combining ProstaScint technology with other molecular imaging technologies, such as CT, to provide more targeted treatments and improve the accuracy of images and richness of the data.
- Investigating molecular imaging techniques that would enable sentinel lymph node biopsy to determine whether prostate cancer has spread. During sentinel lymph node biopsy, the lymph nodes are first mapped to identify the sentinel lymph node—the node that the lymph ducts of the prostate usually drain to first. The sentinel lymph node biopsy removes only that lymph node, which can then be examined for signs of cancer.
- Developing radioimmunotherapy treatments, which combine antibodies with a radionuclide to deliver targeted radiation to prostate cancer cells. Radioimmunotherapy could be particularly useful in treating patients whose prostate cancer has spread to other parts of the body.
- Developing new radiotracers that would enable the use of PET technology for prostate cancer imaging.

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.