Nuclear Medicine Scans for Cancer

Nuclear medicine scans (also known as **nuclear imaging, radionuclide imaging,** and **nuclear scans**) can help doctors find tumors and see how much the cancer has spread in the body (called the cancer's stage[1]). They may also be used to decide if treatment is working. These tests are painless and usually done as an outpatient procedure.

The specific type of nuclear scan you'll have depends on which organ the doctor wants to look into. Some of the nuclear medicine scans most commonly used for cancer (described in more detail further on) are:

- Bone scans
- PET (positron emission tomography) scans
- Thyroid scans
- MUGA (multigated acquisition) scans
- Gallium scans

What do nuclear scans show?

Nuclear scans make pictures based on the body's chemistry (like metabolism) rather than on physical shapes and forms (as is the case with other imaging tests). These scans use liquid substances called **radionuclides** (also called **tracers** or **radiopharmaceuticals**) that release low levels of radiation.

Body tissues affected by certain diseases, such as cancer, may absorb more or less of the tracer than normal tissues. Special cameras pick up the pattern of radioactivity to create pictures that show where the tracer travels and where it collects.

If cancer is present, the tumor may show up on the picture as a "hot spot" – an area of increased cell activity and tracer uptake. Depending on the type of scan done, the tumor might instead be a "cold spot" – a site of decreased uptake (and less cell activity).

Nuclear scans may not find very small tumors, and cannot always tell whether a tumor is really cancer. These scans can show some internal organ and tissue problems better than other imaging tests, but they don't provide very detailed images on their own. Because of this, they're often used along with other imaging tests to give a more complete picture of what's going on. For instance, bone scans that show hot spots on the skeleton are usually followed by x-rays[2] of the affected bones, which are better at showing details of the bone structure.

Some nuclear scans are also used to measure heart function.

How do nuclear scans work?

In most cases you're given a tracer (or radionuclide) that sends out small doses of radiation. Some are swallowed while others are put into a vein or inhaled as a gas.

Over time the tracer collects in the part of the body that's being tested. This can take from a few seconds to several days. The collected tracer sends out gamma rays that are picked up by a special camera (a **gamma camera**,**rectilinear scanner**, or *scintiscan*). The signals are processed by a computer, which turns them into 2- or 3-dimensional (3-D) pictures, sometimes with color added for extra clarity. A radiologist or a doctor who specializes in nuclear medicine interprets the pictures and sends a report to your doctor.

These nuclear medicine scans are commonly used for cancer:

Bone scans: Bone scans look for cancers that may have spread (metastasized) from other places to the bones. They can often find bone changes much earlier than regular x-rays. The tracer collects in the bone over a few hours, then the scans are done.

Positron emission tomography (PET) scans: PET scans usually use a form of radioactive sugar. Body cells take in different amounts of the sugar, depending on how fast they are growing. Cancer cells, which grow quickly, are more likely to take up larger amounts of the sugar than normal cells. You'll be asked to not drink any sugary liquids for several hours before the test.

PET/CT scans: Doctors often use machines that combine a PET scan with a CT scan[3]. PET/CT scanners give information on any areas of increased cell activity (from the PET), as well as show more detail in these areas (from the CT). This helps doctors pinpoint tumors. But they also expose the patient to more radiation.

Thyroid scans: Radioactive iodine (iodine-123 or iodine-131) is swallowed. It goes onto the blood stream and collects in the thyroid gland. This scan can be used to find thyroid cancers. Radioactive iodine can also be used to treat thyroid cancer. This test may not work the way it should if you take in substances that contain iodine contain iodine (such as seaweed, cough syrups, multivitamins, or certain heart medicines). Be sure you tell your doctor about any allergies to seafood or iodine. Talk to the doctor about what you need to do to be ready for this test.

MUGA scans: This scan looks at heart function. It may be used to check heart function before, during, and after certain type of chemotherapy. The scanner shows how your heart moves your blood as it carries the tracer, which binds to red blood cells. The test tells you your ejection fraction, which is the amount of blood pumped out of your heart. 50% or higher is normal. If you have an abnormal result, your doctor may switch you to a different kind of chemotherapy. You may be asked to not use tobacco or caffeine for 24 hours before the test.

Gallium scans: Gallium-67 is the tracer used in this test to look for cancer in certain organs. It can also be used for a whole body scan. The scanner looks for places where the gallium has collected in the body. These areas could be infection, inflammation, or cancer.

Other types of tracers in nuclear scans

Sometimes a special type of antibody made in the lab, called a monoclonal antibody, can be designed to stick to substances found only on the surface of cancer cells. A radioactive substance can be attached to the monoclonal antibody, which is then given into a vein. It travels in the bloodstream until it gets to the tumor and sticks to it. This causes the tumor to "light up" when seen through a special scanner. Your doctor can give you more information if it's recommended that you have one of these tests.

Scientists are always studying new tracers and working to improve the tracers used now

to help diagnose and stage certain types of cancers.

How do I get ready for a nuclear scan?

The steps needed to prepare for a nuclear medicine scan depend on the type of test and the tissue that will be studied. Some scans require that you don't eat or drink for 2 to 12 hours before the test. For others, you may be asked to take a laxative or use an enema. Be sure your doctor or nurse knows everything you take, even over-the-counter drugs, vitamins, and herbs. You may need to avoid some medicines (prescription and over-the-counter) before the test. Your health care team will give you instructions.

Reactions to the radioactive material are very rare. Still, be sure to tell your doctor about any allergies and if you've had problems with nuclear medicine scans in the past.

You may get the radioactive material anywhere from a few minutes to many hours before the test. For example, in a bone scan, the tracer is put into a vein in your arm about 2 hours before the test begins. For gallium scans, the tracer is given a few days before the test.

What can I expect during a nuclear scan?

In most cases you will be given a tracer that sends out small doses of radiation. If it's put into your blood, a needle will be used to put it into a vein in your hand or arm.

Because of the special materials and equipment needed, these scans are usually done in the radiology or nuclear medicine department of a hospital. You might be able to wear your own clothing or you might be given a gown to wear during the test. You'll need to remove all jewelry or metal items that could interfere with the scans.

The scanner has a hole in the middle and looks like a large doughnut. You lie on a padded table which moves back and forth through the hole in the scanner. You will need to be very still while the scans are done. The technician may ask you to change positions to allow different views to be taken. The table may become uncomfortable after a while.

For a thyroid scan, you may sit in a chair that faces the scanner. The scanner is set up so that it's right in front of your neck and your chin rests on top of it. (The thyroid gland is in the front of the neck.)

To get a MUGA scan, you lie on a flat table and a large camera is positioned above your chest.

How long does a nuclear scan take?

A nuclear scan usually takes about 30 to 60 minutes, plus the waiting time after the radioactive material is given.

For **bone scans**, the material takes 2 to 3 hours to be absorbed. During this time, you'll stay in the radiology clinic and will be asked to drink a lot of water to help flush out any tracer that doesn't collect in the bones. The scan itself takes another hour or so.

PET scans take 20 to 30 minutes, but you must wait about an hour while the tracer collects in the organ being studied.

For a **thyroid scan**, you take the radioactive tracer as a liquid or pill about 24 hours before the scan. The scan takes less than 30 minutes.

MUGA scans can take up to 3 hours, depending on how many pictures are needed.

Gallium scans take several days between the injection and the actual scan. Sometimes people are scanned more than once after the injection. The scan takes 30 to 60 minutes.

Results of nuclear scans are usually available within a few days.

What are the possible complications of a nuclear scan?

care team about whether you need to take precautions about having sex, or being close to children or pregnant women after these tests.
- You will be asked to drink a lot of water to flush out the radioactive material.
- To reduce the risk of being exposed to radioactive material in your urine after a scan, you should put the lid down and flush the toilet right after you use it.
- Nuclear scans are rarely recommended for pregnant women, so let your doctor know if you are or might be pregnant.
- If you are breastfeeding, be sure to tell the doctor ahead of time. You may need to pump breast milk and discard it until the radionuclide is gone from your system.

Hyperlinks

1. www.cancer.org/cancer/diagnosis-staging/staging.html
2. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/x-rays-and-other-radiographic-tests.html
3. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/ct-scan-for-cancer.html

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Last Revised: August 25, 2023

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