American Cancer Society®

Imaging (Radiology) Tests

What are imaging tests?

An imaging test is a way to see something that's going on inside your body. These tests send forms of energy (x-rays, sound waves, radioactive particles, or magnetic fields) through the body. The changes in energy patterns made by body tissues create an image or picture. These pictures can show normal body structures and function as well as abnormal ones caused by diseases such as cancer.

Imaging tests are different from *endoscopy* (like a colonoscopy or bronchoscopy), which puts a flexible, lighted tube with a lens or a video camera inside the body. Endoscopy allows doctors to see inside parts of the body as if they were looking with the naked eye – more like real pictures. These are very different from the images the doctor gets from imaging tests. (For more information, see our document called *Endoscopy*.)

What are imaging tests used for?

Imaging tests are used for cancer in many ways:

- They are sometimes used in screening – to look for cancer in its early stages, even though a person has no symptoms. A mammogram is an example of an imaging test used for cancer screening.
- They can be used to look for a mass or lump (tumor) if you have symptoms. They can also help find out if your symptoms are caused by a tumor or by some other type of disease.
- They can sometimes help predict whether a tumor is likely to be cancer. This can help doctors decide if you need a *biopsy* (a tissue sample is taken and looked at under the microscope). A biopsy is almost always needed to know for sure that a tumor is cancer.
- They can show exactly where the tumor is, even deep inside the body. This helps if a sample (biopsy) of the tumor is needed for further study.

- They can help find out the *stage* of the cancer (figuring out how far the cancer has spread).
- They can be used to plan treatment, such as when pinpointing where the beams should be focused in radiation therapy.
- They can show if a tumor has gotten smaller, stayed the same, or grown after treatment. This can give a doctor an idea of how well treatment is working.
- They can help find out if a cancer has come back (*recurred*) after treatment.

Imaging tests are only part of the process of cancer diagnosis and treatment. A complete cancer work-up also includes a careful *medical history* (a series of questions about your symptoms and risk factors), a physical exam, and blood or other lab tests.

Many doctors ask for x-rays or other images to be taken before treatment begins so they can track changes during treatment. These are called *baseline studies* because they show how things looked at the start. Doctors can use them to compare with later images to see the results of treatment over time. They can also be used later on to find out if the cancer has progressed.

Limitations of imaging tests

Imaging tests can find large collections of cancer cells, but no imaging test can show a single cancer cell or even a few. In fact, it takes millions of cells to make a tumor big enough for an area to look abnormal on an imaging test. This is why doctors sometimes recommend treatment even when cancer cells can no longer be seen on an imaging test. Even one surviving cancer cell can grow and, over time, become a tumor that will again be big enough to cause problems and/or show up on an imaging test.

Who does imaging tests and who interprets them?

A doctor, a certified technologist, or other health professional may do an imaging test. Depending on what is involved, the test may be done in a hospital, a special clinic or imaging center, or a doctor’s office. In larger medical centers, imaging tests are usually done in the radiology or nuclear medicine department (even though some types of tests do not involve high-energy radiation).

A radiologist is a specialist in imaging techniques. He or she is the person who usually reads (interprets) the image made during the test. The radiologist writes a report on the findings and sends the report to your doctor. A copy of the report will become part of your patient records. Your other doctors (oncologists, surgeons, etc.) may look at the images, too.

Types of imaging tests

Descriptions of some of the more common types of imaging tests, how they are done, and when you might need them can be found in the following sections.

Computed tomography scan

Also called *CT scan*, *CAT scan*, and *spiral* or *helical CT*.

What does it show?

CT scans show a slice, or cross-section, of the body. The image shows your organs and soft tissues more clearly than standard x-rays. Because the picture is made by a computer, it can be enlarged to make it easier to see and interpret.

Since the late 1970s, CT scans have been very useful in helping doctors find cancer. CT scans can show a tumor’s shape, size, and location, and even the blood vessels that feed the tumor – all without having to cut into the patient.

Doctors often use CT scans to help them guide a needle to remove a tissue sample. This is called a *CT-guided biopsy*. They can also be used to guide needles into tumors for some types of cancer treatments, such as *radiofrequency ablation* (using heat to destroy a tumor).

By comparing CT scans done over time, doctors can see how a tumor is responding to treatment or find out if the cancer is coming back after treatment.

How does it work?

CT scans use controlled amounts of x-rays – beams of high-energy radiation that are passed through the body – to make pictures. In a way, CT scans are like standard x-ray tests (see the “Radiographic studies” section). But an x-ray test uses a broad beam of radiation aimed from only one angle. A CT scan uses a pencil-thin beam to create a series of pictures taken from different angles. Each angle produces a slightly different view of the organs and soft tissues. The information from each angle is fed into a computer, which calculates how the images overlap. The computer then creates a black and white picture that shows a slice of a certain area of the body – much like looking at a single slice from a loaf of bread.

The picture can be made clearer by the use of special contrast materials which can be swallowed as a liquid, put into a vein, or put into the intestines through the rectum as an enema. Because body tissues absorb these materials differently, the CT image will show greater contrast between types of tissues. This allows things like tumors to be seen more clearly.

In recent years, *spiral CT* (also known as *helical CT*) has become the most common type of CT used. It’s a faster machine that uses less radiation than the original CT scanner.

By placing CT image slices on top of each other, the machine can create a 3-dimensional (3-D) scan, which provides even more information about certain cancers. The 3-D image can be rotated on a computer screen to look at different views.

Doctors are now taking CT technology one step further in a technique called *virtual endoscopy*. They can look at the inside surfaces of organs such as the lungs (virtual bronchoscopy) or colon (virtual colonoscopy or *CT colonography*) without actually having to put scopes into the body. They can arrange the 3-D images to create a black and white view on the computer screen, which looks a lot like it would if they were doing an actual endoscopy.

How do I get ready for the test?

CT scans are most often done on an outpatient basis, so you do not need to be in the hospital to get one.

In some cases, your doctor may tell you not to eat or drink overnight or for several hours before the test. Or you may need to use a laxative or an enema to clean out your bowel and remove material that could get in the way of seeing inside the belly and intestines. Depending on the part of the body being studied, you also may need to drink contrast liquid or get a contrast enema before the test. If a contrast material is to be put into a vein, you may have an intravenous (IV) catheter put into a vein in your arm.

You may be asked to undress, put on a robe, and remove any jewelry or other metal objects that may get in the way of the image. You may be asked remove dentures, hearing aids, hair clips, and so on, as they can affect the CT pictures.

What is it like having the test?

A radiological technologist does the CT scan. The scanner is a large, doughnut-shaped machine. You lie on a thin, flat table that slides back and forth inside the hole in the middle of the scanner. As the table moves into the opening, an x-ray tube rotates within the scanner, emitting thousands of tiny x-ray beams at precise angles. These beams pass through your body and are detected on the other side of the scanner. You may hear buzzing and clicking as the scanner switches on and off.

During a CT head scan, your head will be held still in a special device.

You will be alone in the exam room during the CT scan, but the technologist will be able to see, hear, and talk to you at all times.

A CT is painless but you may find it uncomfortable to hold still in certain positions for minutes at a time. You may also be asked to hold your breath for a short time, since chest movement can affect the image. For CT colonography, air is pumped into the colon to help see the inner bowel surface. This can cause discomfort for some.

If you are to be given contrast material in a vein, you will probably have a scan first, then get the contrast dye, and then have a second scan done. When the contrast is given, you may get a feeling of warmth that spreads through your body. Some people say that this can feel like they “wet their pants.” This is only a feeling, and it goes away quickly. You may also get a bitter or metallic taste in your mouth.

How long does it take?

A CT scan can take anywhere from 10 to 30 minutes, depending on what’s being scanned. It depends on how much of your body your doctors want to look at and whether contrast dye is used. It often takes more time to get you into position and give the contrast dye than to take the pictures. After the test, you may be asked to wait while the results are looked at to see if more pictures are needed.

What are the possible complications and side effects?

Some people react in some way to the contrast dye. Possible symptoms include:

- Rash
- Nausea
- Wheezing
- Shortness of breath
- Itching or facial swelling that can last up to an hour

These symptoms usually are usually mild and they most often go away on their own, but they can sometimes signal a more serious reaction that needs to be treated. Be sure to let your radiologic technologist and your health care team know if you begin to have any of them.

Also be sure to let your health care team know if you’ve ever had a reaction to contrast dye, seafood, or iodine in the past. This is important because it may put you at risk for reacting to the contrast dye used in CT scans. In rare cases, people can have a severe allergic reaction that causes low blood pressure or trouble breathing and requires treatment right away. If there is a risk that you might have an allergic response, you may be given a test dose of the contrast material first. When someone has had a severe reaction in the past, they may need to take drugs to prevent another reaction. Sometimes these drugs need to be started the day before the scan.

The IV contrast dye can also cause kidney problems. This is rare, but it is more common in someone whose kidneys already don’t work well. If you need a scan with contrast dye, your doctor will first do a blood test to check your kidney function, to make sure that it is safe.

What else should I know about this test?

- Although a CT scan is sometimes described as a “slice” or a “cross-section,” no cutting is involved.

- The amount of radiation you get during a CT scan is a good deal more than that with a standard x-ray.
- People who are very overweight may have trouble fitting into the CT scanner.
- Tell your doctor if you have any allergies or are sensitive to iodine, seafood, or contrast dyes.
- Tell your doctor if you could be pregnant or are breast-feeding.
- CT scans can cost up to 10 times as much as a standard x-ray.

Magnetic resonance imaging

Other names include *MRI*, *magnetic resonance (MR)*, and *nuclear magnetic resonance (NMR) imaging*.

What does it show?

Like CT scans, MRI creates cross-section pictures of your insides. But MRI uses strong magnets instead of radiation to make the images. An MRI scan can take cross-sectional slices (views) from many angles, as if someone were looking at a slice of your body from the front, from the side, or from above your head. MRI creates pictures of soft tissue parts of the body that are sometimes hard to see using other imaging tests.

MRI is very good at finding and pinpointing some cancers. An MRI with contrast dye is the best way to see brain tumors. Using MRI, doctors can sometimes tell if a tumor is not cancer (benign) or cancerous (malignant).

MRI can also be used to look for signs that cancer may have spread (metastasized) from where it started to another part of the body.

MRI images can also help doctors plan treatment such as surgery or radiation therapy.

Special MRI machines, now available in some hospitals, are designed just for looking inside the breast. This is called an *MRI with dedicated breast coils*. Breast MRI is recommended along with mammograms to look for breast cancer in women at high risk for breast cancer. At this time MRI is not used by itself to detect breast cancer early. (If you think you may be high risk for breast cancer and want more information on breast MRI as part of breast cancer early detection, call 1-800-227-2345.) Breast MRI can also be used in women who have already been diagnosed with breast cancer to better determine the actual size of the cancer and to look for any other cancers in the breast.

How does it work?

An MRI scanner is a cylinder or tube that holds a very strong magnet weighing several tons. As you lie on a table within the tube, the device surrounds you with a powerful magnetic field. The magnetic force causes the nuclei (centers) of hydrogen atoms in your body to line up in one direction. Once the atoms are lined up, the MRI machine gives off a burst of radiofrequency waves. These waves cause the hydrogen nuclei to change direction. When they return to their original position, they give off certain signals that the scanner detects. Hydrogen nuclei in the body tissues change direction in different ways. A computer takes the signals from these changes and converts them into a black and white picture.

Contrast materials can be put in through a vein to improve the quality of the image. Once absorbed by the body, these agents speed up the rate at which tissue responds to the magnetic and radio waves. As a result, the signals produce stronger, clearer pictures.

How do I get ready for the test?

You don’t need a special diet or preparation before an MRI.

Some tests require use of a contrast material before imaging. If contrast is to be used, you may have an intravenous (IV) catheter put in a vein in your arm.

If being in an enclosed space such as the MRI scanner concerns you, you might need to take medicine to help you relax. Talking with the technologist or a patient counselor, or getting a tour of the MRI machine before the test can be helpful. You will be in the exam room alone, but the technologist will be able to see and hear what’s going on. You will also have a call button in case you need to speak with the technologist. In some cases, you can arrange to have the test done with an *open MRI* machine that allows more space around your body (see the next section).

Before the test, you usually will be asked to undress and put on a gown or other clothes without zippers or metal. Be sure to remove all metal objects, like hair clips or jewelry. Before the scan, the MR technologist will ask you if you have any metal in your body, such as surgical clips or staples, pacemakers, artificial joints, metal fragments, tattoos, permanent eyeliners, and so on. Some metallic objects will not cause problems, but others can. You may need to have an x-ray to check for metal objects if there is any doubt.

What is it like having the test?

MRI scans are usually done on an outpatient basis in a hospital or clinic. You will lie down on a narrow, flat table. The technologist may use straps or pillows to make you comfortable and help keep you from moving. The table then slides into a narrow cylinder. The part of your body that is being looked at will be in the center of the cylinder.

The test is painless, but you have to lie still inside the cylinder with its surface a few inches from your face. You may be asked to hold your breath or keep very still during certain parts of the test. The machine may make loud, thumping and whirring noises, much like the sound of a washing machine, as the magnet switches on and off. Some facilities let you wear earplugs or headphones to block this noise out during testing.

Special machines that are less restrictive may be easier for some people. These open MRI machines replace the narrow cylinder with a larger ring. This design lessens the banging sound and the feeling of lying in an enclosed space. But the device does not create as strong a magnetic field. Although open MRI technology is improving, the pictures may not be as clear or detailed as they are with standard MRI. Sometimes, this may require retesting on a standard MRI machine.

You may be given contrast material in a vein or have to swallow it. The contrast material used for an MRI exam is called *gadolinium*. Let the technologist know if you have any kind of allergies.

Breast MRI uses a special machine that only does this test, and contrast material is often used. You have to lie inside a narrow tube, face down, on a platform specially designed for the procedure. The platform has openings for each breast that allow them to be scanned without being compressed. The platform contains the sensors needed to capture the MRI image. It is important to remain very still throughout the exam.

How long does it take?

MRI scans can take between 45 and 60 minutes and sometimes up to 2 hours. After the test, you may be asked to wait while the pictures are checked to see if more are needed.

What are the possible complications?

People can be hurt in MRI machines if they take metal items into the room or if other people leave metal items in the room.

Some people become very uneasy and even panic when lying inside the MRI scanner.

Some people react to the contrast material. Such reactions include:

- Nausea
- Pain at the needle site
- Headache that develops a few hours after the test is over
- Low blood pressure leading to a feeling of lightheadedness or faintness (this is rare)

Be sure to let your health care team know if you have any of these symptoms.

Gadolinium, the contrast material used for MRI, can cause a special complication when it's given to patients on dialysis or who have severe kidney problems, so it is rarely given to these patients. Your doctor will discuss this with you if you have severe kidney problems and need an MRI with contrast.

What else should I know about this test?

- People who are overweight may have trouble fitting into the MRI machine.
- Some kinds of surgical implants that contain metal or are affected by magnets may cause problems due to the strong magnetic field. If you have a pacemaker, surgical clips, staples, an implanted pump, or other device with metal, you may not be able to

have an MRI. Not all metal implants are a problem. Your health care team will ask you questions about these before the MRI test.

- If you have an implanted intravenous (IV) catheter or port, your doctor will need to decide whether you should have an MRI.
- If you have tattoos or permanent makeup (such as eyeliner), let the technologist know so that they can take the needed precautions and ensure the best results.
- The use of MRI during pregnancy has not been well studied. MRI is usually not done in the first 12 weeks of pregnancy unless there is a strong medical reason to use it.
- Do not bring credit cards or other items with magnetic scanning strips with you into the exam room – the magnet could wipe out the information stored on them.
- MRI costs more than a CT scan.
- MRI does not expose you to radiation.
- Many hospitals and imaging centers do not have dedicated breast MRI equipment available. It is important that MRIs done for breast cancer screening in high risk women be done on dedicated breast MRI equipment at facilities that can also perform an MRI-guided breast biopsy. Otherwise, the entire scan will need to be repeated at another facility when the biopsy is done.

Radiographic studies (regular x-rays and contrast studies)

Other names include *radiographs* and *roentgenograms*. For names of contrast studies, see Table 1.

What do they show?

Radiographs, most often called x-rays, produce shadow-like images of certain organs or tissues. X-rays are very good at finding certain bone problems. They can show some organs and soft tissues, but MRI and CT scans often give better pictures of them. Still, x-rays are faster, easy to get, and cost less than other scans, so they may be used to get information quickly.

Mammograms (breast x-rays) are a form of radiographic study (for more information, see the section called “Mammography”).

Special types of x-ray tests called *contrast studies* may use dyes or contrast materials. For example, a lower gastrointestinal (GI) series, often called a *barium enema* exam, takes x-ray pictures after the bowel is filled with barium sulfate (a contrast material). Another contrast study, *intravenous pyelogram* (IVP), uses dye to look at the structure and function of the urinary system (ureters, bladder, and kidneys). See Table 1 for more examples.

With advances in technology, many contrast studies once used for diagnosis are being replaced by other methods, such as CT or MRI scans (see sections on CT and MRI).

How do they work?

A special tube inside the x-ray machine sends out a controlled beam of radiation. Tissues in the body absorb or block the radiation to varying degrees. Dense tissues such as bones block most radiation, but soft tissues, such as fat or muscle, block less. After passing through the body, the beam falls on a piece of film, where it casts a kind of shadow. Tissues that block high amounts of radiation, such as bone, show up as white areas. Soft tissues block less radiation and show up in shades of gray, and organs that are mostly air (such as the lungs) normally look black. Tumors are usually denser than the tissue around them, so they are often seen as lighter shades of gray.

Contrast studies provide some information that standard x-rays cannot. During a contrast study, you get a dose of a contrast material that outlines, highlights, or fills in parts of the body so that they show up more clearly on an x-ray. The contrast material may be given by mouth, as an enema, as an injection (put in a vein), or through a catheter (thin tube) put into various tissues of the body. For most of these tests, the images can be captured either on x-ray film or by a computer.

Table 1: Commonly used contrast studies

Test name(s)	**Organs studied**	**Dye is given by**
angiography, angiogram, arteriography, arteriogram	arteries throughout the body, including those in the brain, lungs, and kidneys	catheter (thin tube) in an artery
intravenous pyelogram (IVP)	urinary tract (kidney, ureters, bladder)	injection into vein (IV)
lower GI (gastrointestinal) series, barium enema (BE), double-contrast barium enema (DCBE), air-contrast barium enema (ACBE)	colon, rectum	Enema
upper GI series, barium swallow, esophagography, small bowel follow through	esophagus, stomach, small intestine	mouth
venography, venogram	veins throughout the body, most often in the leg	catheter in a vein

How do I get ready for the test(s)?

Other than removing metal objects that might interfere with the picture, no special preparation is needed before having a standard x-ray.

Preparation for a contrast study depends on the test. You may be asked not to eat anything or to prepare in other ways before the test (see the next section). The radiology center where you are having the test should give you instructions. Check with them first. Your doctor also may give you instructions.

What is it like having the test(s)?

Standard x-rays: Usually x-rays are taken by an x-ray technologist. You undress to expose the part of the body that will be x-rayed, removing jewelry or other objects that may interfere with the image. You may be given a gown or drape to wear. You will be asked to sit, stand, or lie down, depending on what part of the body will be x-rayed. Your body is put against a flat box that contains the x-ray film. The technologist then moves the machine to aim the beam of radiation at the right area.

You may have special shields put over parts of your body near the area to be x-rayed so that they are not exposed to the radiation. Usually the technologist leaves the room to operate the machine by remote control. Your exposure to the x-ray is very brief − usually less than a second. You may hear a buzzing or clicking sound while the machine is working.

For a chest x-ray, often 2 views are taken. Patients stand with their chest against the x-ray film and the image is taken from the back. Your arms will be at your side. Then often a side view is taken with your arms either above your head or in front of you. The technologist will tell you when to take a deep breath and hold still. For a chest x-ray in patients who can’t stand, the film is placed in back of them and the picture is taken from the front.

During an abdominal (belly) x-ray, you lie down on a table. You may be asked to change position or sit up if more than one view is needed. Again, you will need to hold your breath and lie still while the picture is taken quickly. After the exposure, the technologist will come back to the room to move the machine out of the way, remove any protective shields, collect the film, and help you back to the changing room where you can get dressed.

X-ray angiography: In the past, angiography was often used to learn the stage or extent of cancer, but now CT and MRI scans are most often used to do this. Angiography is sometimes used to show surgeons the blood vessels next to a cancer so the operation can be planned to limit blood loss. Angiograms are still used to diagnose non-cancerous blood vessel diseases. These types of studies are done by a radiologist (a doctor who specializes in imaging), with the help of technologists.

You will be asked to not eat before this test. Usually you will be given medicine to relax you before the test starts. As you lie still on the table, the skin over the injection site is cleaned and numbed. A catheter (thin plastic tube) is put into a blood vessel (usually the artery at the top of the thigh) and slid in until it reaches the area to be studied. The contrast dye is put in, and a series of x-ray pictures is taken. After that, the catheter is removed. Firm pressure may be needed on the site for a while to make sure it doesn't bleed. You will also be asked to lie flat for up to several hours. This helps prevent bleeding at the catheter site, too.

Other types of angiography: Advances in technology have led to other forms of angiography that take less time and mean fewer risks than x-ray angiography. *CT angiography* takes pictures of blood vessels using a CT scanner instead of a standard x-ray machine. The contrast dye can be put into a small vein in the arm instead of having to put a catheter into a major blood vessel. *Magnetic resonance angiography* (MRA) is an MRI study of the blood vessels. It may be done with or without contrast dye, and is also quicker than a standard angiogram.

Intravenous pyelogram (IVP): This x-ray test is used to study kidney function and to look for tumors in the urinary tract.

You will probably be asked not to eat or drink anything for about 12 hours before the test, and you must take laxatives to clean out your bowel. For the test itself, you lie on a table for a series of x-rays. Contrast dye is then given through a vein in your arm. Your kidneys remove the dye from the bloodstream, and it goes into the urinary tract. Another series of x-rays is taken over the next 30 minutes or so. Pressure may be applied to the belly to help make the image clearer. Once the dye has reached the bladder, you will be asked to pass urine while another x-ray is taken.

Lower GI series (barium enema): This x-ray study is used to look at the lining of the colon (large intestine) and rectum.

Your food may be restricted for a few days before the test. Laxatives and/or enemas are used to clean out the colon. For the test, you lie secured on a table, and a series of x-rays is taken. Then liquid barium is put into your colon through a small, soft tube placed in your rectum. The liquid feels cool. More images are taken while the table tilts you into different positions. You have to lie still and hold your breath as each image is taken. After the test, you can go to the toilet to pass the barium solution out of your bowels. (It may take a few days until it is all out. Your stool may be drier, harder, and light colored during this time.)

To get clearer pictures, a "double-contrast" exam is often done. This exam uses a smaller amount of thicker barium liquid. After the barium is in, air is put into your bowel. This can cause a sense of fullness and discomfort, along with an urge to empty your bowels.

Upper GI series (barium swallow): This test is used to study the lining of the esophagus (swallowing tube), stomach, and the duodenum (first part of the small intestine).

You will probably be asked to not eat or drink for 8 to 12 hours before the exam. As with the lower GI series, you lie on a tilting table while a series of x-rays are taken. You will need to swallow a barium mixture a few times during the test. You may also be asked to swallow baking soda to create gas in your stomach. Sometimes pictures are taken a few hours later so the doctor can see the small intestine (it takes time for the barium to move from the stomach to the small intestine). After the test you may be given a laxative to speed up getting the barium out of your body.

Venography: This test can be used to look at veins anywhere in the body. It's most often used to look for a blood clot in a large vein in the leg or arm (called a deep venous thrombosis or DVT), although other tests are often used first.

As you lie still on the table, the skin over the vein to be used is cleaned and numbed. A catheter (thin plastic tube) is then put into a small vein below the vein that might be blocked (like the foot for a vein in the leg, or the hand for a vein in the arm). It may be threaded in so that it passes into a larger vein closer to the one to be studied or a tourniquet may be used so the dye flows into the deeper veins. The contrast dye is put in, and a series of x-ray pictures is taken. After that, the catheter is removed. Firm pressure may be needed on the site for a while to make sure it doesn't bleed.

How long do they take?

- Standard x-ray: about 5 to 10 minutes
- Angiogram: from 1 to 3 hours
- Intravenous pyelogram: about 1 hour
- Lower GI series: 30 to 45 minutes
- Upper GI series: 30 minutes to 6 hours, depending on the part of the digestive system being tested
- Venogram: 30 to 90 minutes

What are the possible complications and side effects of these imaging tests?

Standard x-rays: Problems are rare and very unlikely.

Angiography: You may have a warm or burning feeling as the dye is given. The contrast material may cause nausea, vomiting, flushing, itching, or a bitter or salty taste. In rare cases, people have a severe allergic reaction to the contrast material. The contrast material can also cause kidney problems. This is rare, but it is more common in someone whose kidneys already don't work well.

There is a small risk of a blood clot forming on the end of the catheter, which could block a blood vessel. There is also a small risk of damage to the blood vessel from the catheter, which could lead to internal bleeding. A hematoma (a large collection of blood under the skin) may develop where the catheter was put in if pressure is not kept on the site long enough. (Possible complications of CT or MR angiography are like those described in the sections on CT and MRI).

Intravenous pyelogram (IVP): This test is usually safe, but it should be used with caution (or not at all) in people who are allergic to contrast material with iodine (which also includes CT contrast). The contrast dye causes some people to have nausea, vomiting, flushing, itching, or a bitter or salty taste. In rare cases, people have a severe reaction to the contrast material and need emergency treatment.

Lower GI series (barium enema): The test can be uncomfortable. Some patients have abdominal (belly) cramping. Many patients find the test makes them tired. The barium contrast material will make your stools a light color for a few days after the test and may cause constipation.

Upper GI series (barium swallow): The barium mixture has the thickness of a milkshake and tastes chalky. Baking soda crystals can cause gas and belching. After the test, your stools will be lighter in color for a few days, and you may be constipated.

Venography: This has similar side effects and possible complications as angiography, although flushing is not as common.

What else should I know about these tests?

- X-ray studies expose the body to radiation, but modern x-ray equipment uses the smallest amount of radiation possible. (See "General questions and comments on radiation risk" for more on this.)
- A newer technology, called *digital radiology*, produces pictures on computer screens rather than on film. The size and contrast of the pictures can be adjusted to make them easier to read, and they can be sent to computers in other medical offices or hospitals.

If you are to have a test that uses a contrast dye, tell your doctor if you are allergic to contrast materials, iodine, or to seafood. This may put you at a higher risk for having a reaction.

Mammography

Other names include *mammogram*, and *digital mammography*.

What does it show?

A mammogram is an x-ray of the breast. A *screening mammogram* is used to look for signs of breast disease when you do not have any breast symptoms or problems. A mammogram can detect cancer in its early stages, even before a lump can be felt, when treatment can be most successful. Screening mammograms usually take x-ray pictures of each breast from 2 different angles.

Mammograms can also be used to look at a woman's breast if she has a breast problem or a change seen on a screening mammogram. When used in this way, they are called *diagnostic mammograms*. They may include extra views (images) of the breast that are not usually done on screening mammograms.

Mammograms can’t prove that an abnormal area is cancer, but they can give information that shows whether more testing is needed. The 2 main types of breast changes found with a mammogram are calcifications and masses.

Calcifications are tiny mineral deposits within the breast tissue, which look like small white spots on the pictures. They may or may not be caused by cancer.

A mass, which may or may not have calcifications, is another important change seen on mammograms. Masses can be many things, including cysts (non-cancerous, fluid-filled sacs) and non-cancerous solid tumors, but they could also be cancer. Any mass that is not clearly a cyst usually needs to be biopsied. (A biopsy is taking out a piece of tissue to see if cancer cells are in it.)

Having your older mammograms available for the radiologist is very important. They can help to show that a mass or calcification has not changed for a time, which would mean that it is probably not cancer and a biopsy is not needed.

How does it work?

A mammogram uses a machine designed to look only at breast tissue. The machine takes a different form of x-ray at lower doses than a usual x-ray. Because these x-rays do not go through tissue easily, the machine has 2 plates that compress or flatten the breast to spread the tissue apart. This gives a better picture and uses less radiation.

A digital mammogram (also known as *full-field digital mammography* or FFDM) is like a standard mammogram in that x-rays are used to make a picture of the breast. The differences are in the way the picture is made, looked at, and stored. Standard mammograms are printed on large sheets of photographic film. Digital images are recorded and saved as files in a computer. After the exam, the doctor can look at the pictures on a computer screen and adjust the size, brightness, or contrast to see certain areas more clearly. Digital images can also be sent electronically to another site for other breast specialists to see.

Although many centers do not offer the digital option at this time, it is becoming more widely available. Digital mammograms may be better than standard (film) mammograms for some women, but they are not clearly better for everyone. Women should not skip their regular mammogram if a digital mammogram is not available.

How do I get ready for the test?

If you are still having periods, the best time to schedule a mammogram is one week after your period, when your breasts are likely to be less tender.

You’ll need to undress from the waist up for the exam, so you might want to wear a shirt and a skirt or pants, rather than a dress. No special preparation is needed. But on the day of your mammogram, do not use deodorants, perfumes, powders, or ointments under your arms or on your breasts because these may interfere with the pictures.

What is it like having the test?

A mammogram is an outpatient test. You will be asked to undress from the waist up and may need to remove any jewelry around your neck. You will stand next to the mammogram machine and it will be adjusted to a comfortable height. A specially qualified radiological technologist will position your breast on a platform. The technologist will use the machine to slowly compress your breast with an adjustable plastic plate. The compression will be tight and uncomfortable, but it doesn't last very long. You hold your breath while the technologist leaves the room and quickly takes the picture. Then the pressure is released right away.

A screening mammogram usually means 2 views of each breast − one from the top and one from the side. You may need to have more pictures taken to include as much breast tissue as possible if you have breast implants. You also will have more pictures taken if the mammogram is being used for diagnosis (a diagnostic mammogram) or to guide needle placement for a biopsy.

How long does it take?

The screening mammogram from start to finish takes about 15 to 30 minutes. A diagnostic mammogram, which takes images from more angles or close-up views, takes about 30 to 45 minutes. The breast is compressed for only a few seconds of that time.

What are the possible complications?

A mammogram uses low doses of radiation and is safe. The very low risk that cancer may result from exposure to radiation during a mammogram is far outweighed by the benefits of finding cancer early.

Some women find that mammograms are painful, but for most the compression causes only brief discomfort.

There have been reports of breast implant ruptures during mammograms, but these are very rare. If you have breast implants, find a radiologist experienced in doing mammograms on women with implants and be sure to let the facility know about this ahead of time.

What else should I know about this test?

- The American Cancer Society has guidelines for the early detection of breast cancer in women who are not having breast symptoms. You can learn more in *Breast Cancer: Early Detection*.

- Mammograms alone cannot find all breast cancers. For this reason, mammograms should be used along with a clinical breast exam by a health care professional. Knowing how your breasts normally look and feel, and reporting any changes to a doctor, is also very important.

- A negative mammogram (no sign of calcifications or masses) does not always mean that cancer is not present or that cancer will not develop later.
- The need for a biopsy does not mean that you have cancer. About 8 out of 10 breast biopsies turn out to be benign (not cancer).
- For more details on mammograms and other tests related to breast cancer, please see our document called *Mammograms and Other Breast Imaging Procedures*.

Nuclear scans

Other names include *nuclear imaging*, *radionuclide imaging*, and *nuclear medicine scans*.

What do they show?

Nuclear scans make pictures based on the body's chemistry rather than on physical shapes and forms (as is the case with other imaging tests). These scans use substances called *radionuclide*s (also called *tracers* or *radiopharmaceuticals*) that release low levels of radiation. The amount of radioactivity used is very small and not known to cause harm.

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 material travels and where it collects. These scans show some internal organ and tissue problems better than standard x-ray images.

If cancer is present, the tumor may show up on the picture as a "hot spot" − an area of increased tracer uptake. Depending on the type of scan done, the tumor may instead be a "cold spot" − a site of decreased uptake.

Nuclear scans are used to find tumors. They are also used to study a cancer's stage (the extent of its spread) and to decide if treatment is working.

Nuclear scans may not find very small tumors, and cannot always tell the difference between benign (not cancer) and malignant (cancer) tumors. They are often used along with other imaging tests to give a more complete picture of what is going on. For example, bone scans that show "hot spots" on the skeleton are usually followed by x-rays of the affected bones, which are better at showing details of the bone structure.

Nuclear scans have different names, depending on the organ involved. Some of the more commonly used nuclear scans (described in more detail further on) are:

- Bone scans
- Gallium scans
- PET scans
- Thyroid scans
- MUGA scans

How do they work?

The type of scan done depends on what organ or tissue the doctor wishes to study. In most cases you are given a substance that sends out small doses of radiation. Some are swallowed while others are given into a vein or inhaled as a gas.

Radionuclide scans: Because they look at more than just the shape of a tumor, radionuclide scans are used for more than just creating pictures. Here are some of the more common radionuclides now in use:

- Gallium-67 is used to look for cancer in certain organs. It can also be used for a whole body scan. This may be called a *gallium scan*.
- Technetium-99 is used in whole body scans, especially in *bone scans*. Bone scans look for cancers that may have spread (metastasized) from other places to the bones. Technetium-99 is also used in heart scans, including the MUGA scan which looks at heart function.
- Thallium-201 scans, more often used in cardiology (the study of heart disease), are sometimes used to look at how well treatment is working for certain kinds of tumors and may be used to find some types of cancer.
- Radioactive iodine (iodine-123 or iodine-131) can be used to find and treat thyroid cancers.

Radionuclides send out gamma rays which are picked up by a special camera (known as 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.

Positron emission tomography scans: Positron emission tomography (PET) is a scan that uses a form of radioactive sugar. Body cells take in different amounts of the radioactive 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. The radioactive sugar gives off tiny atomic particles called *positrons*, which run into electrons in the body, giving off gamma rays. A special camera picks up these rays as they leave the body and turns them into pictures.

PET scans are used to find cancer and to see if it is responding to treatment. The chemical changes they show can also help doctors look at the effects of cancer treatment. Because PET scans look at body function, they may show changes that suggest disease before the changes can be seen on other imaging tests.

PET/CT scans: Some machines combine a PET scan with a CT scan. PET/CT scanners give more detailed information on the location of any increased cell activity, helping doctors pinpoint tumors.

Use of monoclonal antibodies in nuclear scans: A special type of antibody produced 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. Examples of monoclonal antibody scanning used to look at cancers are the ProstaScint® scan for prostate cancer, the OncoScint® scan for ovarian cancer, and the CEA-Scan® for colon cancer.

How do I get ready for the test?

The steps needed to prepare for a nuclear 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.

The radioactive material can be given by mouth, put into a vein (IV), or inhaled as a gas. You may get it 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 is it like having the test?

In most cases, a nuclear scan done is done as an outpatient. Because of the special materials and equipment needed, the scans are usually done in the radiology or nuclear medicine department of a hospital.

The scanner has a hole in the middle and looks like a large doughnut. You lie on a padded table which fits through the hole and the scanner moves back and forth. The technician may ask you to change positions to allow different views to be taken. The test is not painful. But you may get uncomfortable after lying on the table for a while.

If you are having a brain scan, many sets of pictures may be needed. The first scans are taken as the radioactive material moves through the arteries into the brain. The second set, taken a few hours later, shows the material in the brain itself. You will be asked to move your head into different positions. Likewise, a thyroid scan may require 2 sets of scans using doses of radioactive iodine that you swallow.

How long does it take?

A nuclear scan 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, and the scan itself takes another hour or so. Gallium scans take several days between the injection and the actual scan. Results of nuclear scans are usually available within a few days.

What are the possible complications?

For the most part, nuclear scans are safe tests. The doses of radiation are very small, and the radionuclides have a low risk of being toxic or causing an allergic reaction. Some people may have pain or swelling at the site where the material is injected. Rarely, some people will develop a fever or allergic reaction when given a monoclonal antibody.

What else should I know about these tests?

- The amount of radiation exposure from a nuclear scan is about the same as that from standard x-rays. The scanner itself does not put out radiation. The body gets rid of the radionuclide used for the test within a few hours or a few days. Talk to your health care team about having sex, or being close to children or pregnant women during this time.
- You will be asked to drink a lot of water to flush out any of the radioactive material that is not absorbed.
- To reduce the risk of exposure to radioactive material in your urine after a scan, you should flush the toilet as soon as 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 breast-feeding, 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.

Ultrasound

Other names include *ultrasonography*, *sonography*, or *sonogram*.

What does it show?

An ultrasound machine creates images called sonograms by giving off high-frequency sound waves that go through your body. As the sound waves bounce off your organs and tissues, they create echoes.

Ultrasound is very good at giving pictures of some diseases of soft tissues that do not show up well on x-rays. Ultrasound is also a good way to tell fluid-filled cysts from solid tumors because they make very different echo patterns.

Ultrasound images are not as detailed as those from CT or MRI scans. Ultrasound cannot tell a benign (not cancer) tumor from one that is cancer. Its use is also limited in some parts of the body because the sound waves cannot go through air (such as in the lungs) or through bone.

Doctors often use ultrasound to guide a needle to do a biopsy (taking out fluid or small tissue samples to be looked at under a microscope). The doctor looks at the ultrasound screen while moving the needle and can see the needle moving toward and into the tumor.

For some types of ultrasound exams, the *transducer* (the wand that produces the sound waves and detects echoes) is placed on the skin surface. The sound waves pass through the skin and reach the organs underneath. In other cases, to get the best images, the doctor must use a transducer that is put into a body opening, such as the esophagus (the tube connecting the throat and the stomach), rectum, or vagina.

Special ultrasound machines, known as *Doppler flow machines*, are able to show how blood flows through vessels. This is helpful because blood flow is different in tumors than in normal tissue. Some of these machines make color pictures. Unlike other forms of blood vessel imaging, *color Doppler* studies do not use contrast agents. Color Doppler has made it easier for doctors to find out if cancer has spread into blood vessels, especially in the liver and pancreas.

How does it work?

An ultrasound machine has 3 key parts: a control panel, a display screen, and a transducer, which looks a lot like a microphone or a computer mouse. The transducer sends out sound waves and picks up the echoes. The doctor or ultrasound technologist moves the transducer over the part of the body being studied. The computer inside the main part of the machine analyzes the signals and puts an image on the display screen.

The shape and intensity of the echoes depend on how dense the tissue is. For example, most of the sound waves pass right through a fluid-filled cyst and send back very few or faint echoes, which makes them look black on the display screen. But the waves will bounce off a solid tumor, creating a pattern of echoes that the computer will show as a lighter-colored image.

How do I get ready for the test?

As a rule, no preparation is needed, but it depends on what is being studied. Your doctor or nurse will give you instructions about any steps to take before your test. Depending on the organ being studied, you may need to not eat, take a laxative, or use an enema. If you are having an abdominal (belly) ultrasound, you may need to drink a lot of water just before the study to fill your bladder. This will create a better picture because sound waves travel well through fluid.

What is it like having the test?

Ultrasound can be done in a doctor’s office, clinic, or hospital. You will lie down on a table. The technologist will put a gel on your skin and move the transducer over the area. The gel both lubricates the skin and helps conduct the sound waves. The gel feels cool and slippery. If a probe is used, it will be covered with gel and put into the body opening. This can cause pressure or discomfort.

During the test the technologist or the doctor moves the transducer. You may be asked to hold your breath during the scan. The operator may adjust knobs or dials to increase the depth to which the sound waves are sent. You may feel slight pressure from the transducer, but you will not hear the high-frequency sounds.

How long does it take?

An ultrasound usually takes 20 to 30 minutes. The length of time depends on the type of exam and how hard it is to find any changes in the organs being studied.

What are the possible complications?

Ultrasound is a very safe procedure with a low risk of complications.

What else should I know about this test?

- Ultrasound does not use radiation.
- Ultrasound usually costs much less than CT or MRI.
- The quality of the results depends to a large extent on the skill of the technologist or doctor operating the transducer, which is not the case with CT or MRI.
- Good images are harder to get in people who are obese.
- Newer forms of ultrasound can provide 3-D images.

Categories of some common imaging tests

Angiogram: see “Radiographic studies”

Arteriogram: see “Radiographic studies – Angiogram”

Barium enema: see “Radiographic studies – Lower GI series”

Barium swallow: see “Radiographic studies – Upper GI series”

Bone scan: see “Nuclear scans”

Gastrointestinal series: see “Radiographic studies – upper and lower GI series”

Positron emission tomography (PET): see “Nuclear scans”

Pyelogram, intravenous (IVP): see “Radiographic studies”

X-ray: see “Radiographic studies”

General questions and comments on radiation risk

In large doses, radiation can cause serious tissue damage and increase a person's risk of later developing cancer. The low doses of radiation used for imaging tests might increase a person's cancer risk slightly, but it is important to put this risk into perspective. In this section we will answer some of the more common questions people have about radiation risks linked to imaging tests.

How much does an imaging test increase a person's radiation exposure?

Background and non-medical radiation

We are constantly exposed to radiation from a number of sources, including radioactive materials in our environment and cosmic rays from outer space. This is called *background radiation*.

The average person is exposed to about 3 mSv (*millisieverts*) of radiation from natural sources over the course of a year. (A millisievert is a measure of radiation exposure.) Much of this exposure is from *radon*, a natural gas with levels that vary across the country.

Because the earth's atmosphere blocks some cosmic rays, living at a higher altitude increases a person's exposure. For example, residents in the plateaus of New Mexico and Colorado, have an annual exposure level of about 1.5 mSv more than people living at sea level. And a 5-hour airline flight increases exposure by about 0.03 mSv.

Smoking a pack of cigarettes a day exposes the smoker to an extra 53 mSv per year.

Radiation from imaging tests

A single chest x-ray exposes the patient to about 0.1 mSv, which is about the radiation dose people are exposed to naturally over the course of 10 days. A mammogram exposes a woman to 0.4 mSv, or about the amount of exposure a person would expect to get in about 7 weeks.

Some other imaging tests have higher exposures. A lower GI series using standard x-rays exposes a person to about 8 mSv. A CT scan of the abdomen (belly) and pelvis exposes a person to about 15 mSv, this goes up to 30 mSv if the test is repeated with and without contrast. A CT colonography exposes you to about 10 mSv of radiation. Keep in mind that these are estimates, and recent studies have found that the amount of radiation you get can vary a great deal.

If you have concerns about the radiation you may get from a CT scan, check with the facility that will perform the test. (Remember that MRI and ultrasound exams do not expose a person to radiation.)

How much does the extra radiation increase a person’s cancer risk?

It is hard to know how much the radiation exposure from imaging tests increases a person’s cancer risk. Most studies on radiation and cancer risk have looked at people exposed to very high doses of radiation, such as uranium miners and atomic bomb survivors. The risk from low-level radiation exposure is not easy to calculate from these studies.

Researchers have estimated that radiation exposure from the average diagnostic x-ray may increase cancer risk very slightly (likely on the order of hundredths to thousandths of one percent). Of course, this can be affected by the type of test done, the area of the body exposed, and other factors.

We do know that children are more sensitive to radiation and should be protected from it as much as possible.

Because radiation exposure from all sources can add up over a lifetime, and radiation can, indeed, increase cancer risk, imaging tests that use radiation should only be done for a good reason. In many cases, other imaging tests such as ultrasound or MRI may be used. But if there is a reason to believe that an x-ray or CT scan is the best way to look for cancer or other diseases, the patient will most likely be helped more than the small dose of radiation can hurt.

How imaging tests are used in certain types of cancer

Many different scans are used to get images of what is happening inside the body, including x-rays, ultrasound, MRI, nuclear medicine scans, and so on. The tests your health care team recommends may depend on a number of factors, such as:

- Where the tumor is and what type it is; some imaging studies work better for certain organs or tissues
- Whether or not a biopsy (tissue sample) is needed
- The balance between any risks or side effects and the expected benefits
- The costs

Table 2 lists the more common imaging tests that may be used for various types of cancers. Other types of tests, such as endoscopy (looking at body organs or cavities using a thin flexible tube that holds a camera), may be used along with or in place of those listed.

More information about the tests used for a certain cancer can be found in our document about that cancer. For example, our Bladder Cancer document talks about tests used to find and stage bladder cancer.

Tests are chosen based on the extent and type of cancer. If you have questions about a test that your health care team wants you to have, ask them to explain the purpose of the test.

Table 2: Common cancer-related uses of imaging tests

Body part	**Why test is used***	**Imaging test**
Bladder and ureters	Detection	Intravenous pyelogram, endoscopy (preferred)
	Staging	MRI or CT of the pelvis, ultrasound
Breast	Screening	Mammogram (screening), MRI with mammogram in some women at high risk
	Detection	Mammogram (diagnostic), ultrasound, MRI,
	Image-guided biopsy	Mammogram, CT-guided biopsy, MRI, ultrasound
	Staging	Chest x-ray, nuclear scan (bone scan), CT or MRI
Brain and spinal cord	Detection	MRI (usually preferred), CT
	Image-guided biopsy	CT or MRI
	Staging	CT or MRI, chest x-ray
Colon and rectum	Screening	Lower GI series (barium enema with air contrast), CT colonography (virtual colonoscopy)
	Detection	Lower GI series (barium enema with air contrast), endoscopy (preferred)
	Staging	CT of abdomen (belly) and chest, ultrasound (with rectal probe to check depth of rectal cancer invasion), MRI
Endometrium	Staging	MRI (gives information about spread

(lining of the uterus)		to lymph nodes; usually surgery is done for primary staging), ultrasound with vaginal probe, CT
Esophagus (swallowing tube)	Detection	Upper GI series (barium swallow), endoscopy (preferred)
	Staging	Ultrasound (with probe in the esophagus to check for spread of cancer), CT of chest and abdomen (belly)
Head and neck	Staging	CT or MRI to look at tumor size and spread, chest x-ray
Kidney	Detection	Ultrasound, intravenous pyelogram, CT, MRI
	Staging	Chest x-ray, CT of abdomen (belly) and chest, MRI (to check for spread into nearby veins), bone scan
Liver	Detection	CT, MRI, ultrasound
	Image-guided biopsy	CT, ultrasound
	Staging	CT, MRI, angiogram to see blood vessels around the tumors
Lung	Detection	Chest x-ray, CT
	Image-guided biopsy	CT
	Staging	CT of chest, head, abdomen (belly), MRI, bone scan
Non-Hodgkin lymphoma and Hodgkin disease	Detection	CT, MRI, ultrasound
	Image-guided biopsy	CT
	Staging	CT, MRI, chest x-ray, bone scan, PET or PET/CT
Ovary	Detection	Ultrasound, MRI, CT

	Staging	CT, MRI, or PET may be done before surgery, chest x-ray
Pancreas	Detection/diagnosis	CT, MRI, ultrasound (with probe inserted through the esophagus [swallowing tube] for better pictures)
	Image-guided biopsy	CT, ultrasound
	Staging	CT, MRI
Prostate	Detection	Ultrasound with rectal probe
	Image-guided biopsy	Ultrasound with rectal probe
	Staging	CT or MRI, monoclonal antibody nuclear scan (ProstaScint®), bone scan
Soft tissue (muscle, tendons, fat)	Detection	CT, MRI
	Image-guided biopsy	CT
	Staging	CT (of chest, head, abdomen/belly, and sometimes pelvis), MRI
Stomach	Detection/diagnosis	Upper GI series (barium swallow with double contrast), endoscopy (preferred)
	Staging	Ultrasound (with probe inserted through the esophagus [swallowing tube] for better images), CT, chest x-ray
Thyroid	Detection/diagnosis	Nuclear medicine scan, ultrasound (to see if lump is solid or a cyst filled with fluid)
	Image-guided biopsy	Ultrasound
	Staging	Nuclear medicine, CT

CT = Computed tomography
MRI = Magnetic resonance imaging
PET = Positron emission tomography
GI = Gastrointestinal

***Why tests is used**

Screening refers to those tests used to find a disease, such as cancer, in people who do not have symptoms of that disease.

Detection refers to tests used if your doctor has special reason to think that you may have a disease like cancer. These reasons could include symptoms, changes seen on your physical exam, or changes seen on screening tests. Imaging tests for detection can help find a mass or other abnormal tissue and can often predict whether it is likely to be cancer or some other type of disease. Still, in almost all cases, a tissue sample (biopsy) must be taken and looked at under the microscope to know if cancer is present.

Image-guided biopsy refers to the use of imaging tests to help guide a biopsy needle into the area of concern. An image-guided biopsy can often allow the doctor to get tissue for study that might otherwise require surgery to reach.

Staging is the process of finding out how far a cancer has grown and spread. Imaging tests are often used to estimate the size of a cancer; to find out how far it has spread in the organ in which it started; and to see if it has spread to nearby tissues and organs, nearby lymph nodes, or distant organs. Most of the tests used for staging are used to look for metastases (spread) to distant organs or tissues. For instance, men with prostate cancer often have bone scans to see if the cancer has spread to bones.

Selection of imaging tests for staging will depend on the doctor's impression of how far the cancer is likely to have spread, based on symptoms and other factors. These tests may not be done in people who have small tumors that do not seem to have spread. People with larger cancers or cancers that have already spread to lymph nodes may need tests such as nuclear scans, CT scans, or MRI to look for distant spread. People with bone pain, nerve-related symptoms (such as numbness, paralysis, or problems with balance or coordination), or other symptoms suggesting distant spread will need more careful evaluation by imaging tests.

To learn more

More information from your American Cancer Society

The following information may also be helpful. These materials may be read on our Web site, www.cancer.org, or ordered from our toll-free number, 1-800-227-2345.

Endoscopy

Mammograms and Other Breast Imaging Procedures

Choosing a Doctor and a Hospital

Health Professionals Associated With Cancer Care

National organizations and Web sites*

Along with the American Cancer Society, other sources of information and support include:

American College of Radiology (ACR)
Toll-free number: 1-800-227-5463
Web site: www.acr.org

> Has information on radiology procedures, radiation safety, FAQs, and a radiology glossary; also has a list of accredited facilities

National Cancer Institute
Cancer Imaging Program
Toll-free number: 1-800-422-6237
Telephone for imaging program: 301-496-9531
Web site: http://imaging.cancer.gov

> For details and sample images on various imaging studies used in cancer care.

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

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