

Computed Tomography (CT) - Chest

Computed tomography (CT) of the chest uses special x-ray equipment to examine abnormalities found in other imaging tests and to help diagnose the cause of unexplained cough, shortness of breath, chest pain, fever and other chest symptoms. CT scanning is fast, painless, noninvasive and accurate. Because it is able to detect very small nodules in the lung, chest CT is especially effective for diagnosing lung cancer at its earliest, most curable stage.

Tell your doctor if there is a possibility you are pregnant and discuss any recent illnesses, medical conditions, medications you are taking, and allergies. You will be instructed not to eat or drink anything for a few hours beforehand. If you have a known allergy to contrast material, your doctor may prescribe medications to reduce the risk of an allergic reaction. These medications must be taken beginning 12 hours prior to your exam. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.



For information on coronavirus (COVID-19) or how COVID-19 vaccine side effects could affect your imaging results, see the [Medical Imaging and Coronavirus Safety](http://www.radiologyinfo.org/info/psa-coronavirus) (<http://www.radiologyinfo.org/info/psa-coronavirus>) page.

What is CT Scanning of the Chest?

Computed tomography, more commonly known as a CT or CAT scan, is a diagnostic medical imaging test. Like traditional x-rays, it produces multiple images or pictures of the inside of the body.

The cross-sectional images generated during a CT scan can be reformatted in multiple planes. They can even generate three-dimensional images. These images can be viewed on a computer monitor, printed on film or by a 3D printer, or transferred to a CD or DVD.

CT images of internal organs, bones, soft tissue and blood vessels provide greater detail than traditional x-rays, particularly of soft tissues and blood vessels.

Using a variety of techniques, including adjusting the radiation dose based on patient size and new software technology, the amount of radiation needed to perform a chest CT scan can be significantly reduced. A low-dose chest CT produces images of sufficient quality to detect many lung diseases and abnormalities using much less radiation than a conventional chest CT scan—in some cases lowering the dose by 65 percent or more. Low dose chest CT is routinely used for evaluation of acquired and congenital lung abnormalities, such as pneumonia, interstitial lung disease or tumor evaluation. There is ongoing research to lower radiation doses even further. Your radiologist will decide the proper settings to be used for your scan depending on your medical problems and what information is needed from the CT scan. If your child is to have a CT scan, the proper low-dose pediatric settings should be used.

What are some common uses of the procedure?

Chest CT is used to:

- examine abnormalities found on conventional chest x-rays.
- help diagnose the causes of clinical signs or symptoms of disease of the chest, such as cough, shortness of breath, chest pain, or fever.
- detect and evaluate the extent of tumors that arise in the chest, or tumors that have spread there from other parts of the body.
- assess whether tumors are responding to treatment.
- help plan radiation therapy.
- evaluate injury to the chest, including the heart, blood vessels, lungs, ribs and spine.
- evaluate abnormalities of the chest found on fetal ultrasound examinations.

Chest CT can demonstrate various lung disorders, such as:

- benign and malignant tumors.
- pneumonia.
- tuberculosis.
- bronchiectasis, cystic fibrosis (<http://www.radiologyinfo.org/en/info/cysticfibrosis>) .
- inflammation or other diseases of the pleura (the covering of the lungs).
- interstitial and chronic lung disease.
- congenital abnormalities.

CT scanning has recently been approved for screening asymptomatic people who have smoked a significant amount of cigarettes by the Centers for Medicare and Medicaid Services. *See the Lung Cancer Screening* (<http://www.radiologyinfo.org/en/info/screening-lung>) page for more information.

A CT angiogram (CTA) may be performed to evaluate the blood vessels (arteries and veins) in the chest. This involves the rapid injection of an iodine-containing fluid (contrast material) into a vein while obtaining CT images. *See the CT Angiography* (<http://www.radiologyinfo.org/en/info/angiact>) (CTA) page for more information.

How should I prepare?

You should wear comfortable, loose-fitting clothing to your exam. You may need to wear a gown during the procedure.

Metal objects, including jewelry, eyeglasses, dentures and hairpins, may affect the CT images. Leave them at home or remove them prior to your exam. You may also be asked to remove hearing aids and removable dental work. Women will be asked to remove bras containing metal underwire. You may be asked to remove any piercings, if possible.

You will be asked not to eat or drink anything for a few hours beforehand, if contrast material will be used in your exam. You should inform your physician of all medications you are taking and if you have any allergies. If you have a known allergy to contrast material, your doctor may prescribe medications (usually a steroid) to reduce the risk of an allergic reaction. To avoid unnecessary delays, contact your doctor before the exact time of your exam.

Also inform your doctor of any recent illnesses or other medical conditions and whether you have a history of heart disease, asthma, diabetes, kidney disease or thyroid problems. Any of these conditions may increase the risk of an adverse effect.

Women should always inform their physician and the CT technologist if there is any possibility that they may be pregnant. *See the*

What does the equipment look like?

The CT scanner is typically a large, donut-shaped machine with a short tunnel in the center. You will lie on a narrow examination table that slides in and out of this short tunnel. Rotating around you, the x-ray tube and electronic x-ray detectors are located opposite each other in a ring, called a gantry. The computer workstation that processes the imaging information is located in a separate control room. This is where the technologist operates the scanner and monitors your exam in direct visual contact. The technologist will be able to hear and talk to you using a speaker and microphone.

How does the procedure work?

In many ways, a CT scan works like other x-ray exams. Different body parts absorb x-rays in different amounts. This difference allows the doctor to distinguish body parts from one another on an x-ray or CT image.

In a conventional x-ray exam, a small amount of radiation is directed through the part of the body being examined. A special electronic image recording plate captures the image. Bones appear white on the x-ray. Soft tissue, such as the heart or liver, shows up in shades of gray. Air appears black.

With CT scanning, several x-ray beams and electronic x-ray detectors rotate around you. These measure the amount of radiation being absorbed throughout your body. Sometimes, the exam table will move during the scan, so that the x-ray beam follows a spiral path. A special computer program processes this large volume of data to create two-dimensional cross-sectional images of your body. These images are then displayed on a monitor. CT imaging is sometimes compared to looking into a loaf of bread by cutting the loaf into thin slices. When the image slices are reassembled by computer software, the result is a very detailed multidimensional view of the body's interior.

Refinements in detector technology allow nearly all CT scanners to obtain multiple slices in a single rotation. These scanners, called multi-slice or multidetector CT, allow thinner slices to be obtained in a shorter amount of time. This results in more detail and additional view capabilities.

Modern CT scanners can scan through large sections of the body in just a few seconds, and even faster in small children. Such speed is beneficial for all patients. It's especially beneficial for children, the elderly and critically ill – anyone who finds it difficult to stay still, even for the brief time necessary to obtain images.

For children, the CT scanner technique will be adjusted to their size and the area of interest to reduce the radiation dose.

To produce high-quality scans at a lower radiation dose, low-dose CT scanning uses a variety of techniques, including:

- dose modulation, in which radiation dosage is continuously adjusted to the patient's size at each location as the patient moves through the scanner
- "noise management" software to filter out unnecessary data
- the use of shields (this method depends on the type of CT scanner being used)
- external shields made out of bismuth may be placed on the patient
- the x-ray tube may be turned off during part of its rotation
- lower peak voltage settings

Your radiologist will select the appropriate dose reduction method(s) to accomplish the lowest possible dose necessary to answer the clinical question at hand.

How is the procedure performed?

The technologist begins by positioning you on the CT exam table, usually lying flat on your back. Straps and pillows may be used to help you maintain the correct position and remain still during the exam.

Many scanners are fast enough that children can be scanned without sedation. In special cases, sedation may be needed for children who cannot hold still. Motion will cause blurring of the images and degrade the quality of the examination the same way that it affects photographs.

If a contrast material is used, it will be injected into a vein shortly before scanning begins.

Next, the table will move quickly through the scanner to determine the correct starting position for the scans. Then, the table will move slowly through the machine as the actual CT scanning is performed. Depending on the type of CT scan, the machine may make several passes.

You may be asked to hold your breath during the scanning. Any motion, including breathing and body movements, can lead to artifacts on the images. This loss of image quality can resemble the blurring seen on a photograph taken of a moving object.

When the exam is complete, you will be asked to wait until the technologist verifies that the images are of high enough quality for accurate interpretation.

The actual CT scanning takes less than 30 seconds and the entire process, including exam preparation, is usually completed within 30 minutes.

What will I experience during and after the procedure?

CT exams are generally painless, fast and easy. With multidetector CT, the amount of time that the patient needs to lie still is reduced.

Though the scan is painless, you may have some discomfort from remaining still for several minutes or from placement of an IV. If you have a hard time staying still, are very nervous, anxious or in pain, you may find a CT exam stressful. The technologist or nurse, under the direction of a doctor, may offer you some medication to help you tolerate the CT exam.

If an intravenous contrast material is used, you will feel a pin prick when the needle is inserted into your vein. You may feel warm or flushed while the contrast is injected. You also may have a metallic taste in your mouth. This will pass. You may feel a need to urinate. However, this is a contrast effect and subsides quickly.

When you enter the CT scanner, you may see special light lines projected onto your body. These lines are used to ensure that you are properly positioned. With modern CT scanners, you may hear slight buzzing, clicking and whirring sounds. These occur as the CT scanner's internal parts, not usually visible to you, revolve around you during the imaging process.

You will be alone in the exam room during the CT scan, unless there are special circumstances. For example, sometimes a parent wearing a lead shield may stay in the room with their child. However, the technologist will always be able to see, hear and speak with you through a built-in intercom system.

After a CT exam, the technologist will remove the intravenous line used to inject the contrast material. The tiny hole made by the needle will be covered with a small dressing. You can return to your normal activities.

Who interprets the results and how do I get them?

A radiologist (<http://www.radiologyinfo.org/en/info/article-your-radiologist>), a doctor specially trained to supervise and interpret radiology exams, will analyze the images. The radiologist will send an official report to the doctor who ordered the exam.

Follow-up exams may be needed. If so, your doctor will explain why. Sometimes a follow-up exam is done because a potential

abnormality needs further evaluation with additional views or a special imaging technique. A follow-up exam may also be done to see if there has been any change in an abnormality over time. Follow-up exams are sometimes the best way to see if treatment is working or if an abnormality is stable or has changed.

What are the benefits vs. risks?

Benefits

- CT is fast, which is important for patients who have trouble holding their breath.
- CT is widely available.
- CT scanning is painless, noninvasive and accurate.
- A major advantage of CT is its ability to image bone, soft tissue and blood vessels all at the same time.
- Unlike conventional x-rays, CT scanning provides very detailed images of many types of tissue as well as the lungs, bones, and blood vessels.
- CT examinations are fast and simple; in emergency cases, they can reveal internal injuries and bleeding quickly enough to help save lives.
- CT has been shown to be a cost-effective imaging tool for a wide range of clinical problems.
- CT is less sensitive to patient movement than MRI.
- CT can be performed if you have an implanted medical device of any kind, unlike MRI.
- CT imaging provides real-time imaging, making it a good tool for guiding minimally invasive procedures such as needle biopsies and needle aspirations of many areas of the body, particularly the lungs, abdomen, pelvis and bones.
- A diagnosis determined by CT scanning may eliminate the need for exploratory surgery and surgical biopsy.
- No radiation remains in a patient's body after a CT examination.
- X-rays used in CT scans should have no immediate side effects.
- Low-dose CT scans of the chest use a lower dose of radiation than conventional chest CT.

Risks

- There is always a slight chance of cancer from excessive exposure to radiation. However, the benefit of an accurate diagnosis far outweighs the risk.
- The effective radiation dose for this procedure varies. *See the Radiation Dose in X-Ray and CT Exams (<http://www.radiologyinfo.org/en/info/safety-xray>) page for more information about radiation dose.*
- Women should always tell their doctor and x-ray or CT technologist if there is any chance they are pregnant. *See the Safety in X-ray, Interventional Radiology and Nuclear Medicine Procedures (<http://www.radiologyinfo.org/en/info/safety-radiation>) page for more information about pregnancy and x-rays.*
- CT scanning is, in general, not recommended for pregnant women unless medically necessary because of potential risk to the unborn baby.
- The risk of serious allergic reaction to contrast materials that contain iodine is extremely rare, and radiology departments are well-equipped to deal with them.
- In some patients with reduced kidney function, the dye used in CT scanning may worsen kidney function.
 - Because children are more sensitive to radiation, they should have a CT exam only if it is essential for making a diagnosis and should not have repeated CT exams unless absolutely necessary. CT scans in children should always be done with low-dose technique.

What are the limitations of CT Scanning of the Chest?

A person who is very large may not fit into the opening of a conventional CT scanner or may be over the weight limit—usually

450 pounds—for the moving table.

Magnetic resonance imaging (MRI) may be better than CT for showing some types of soft-tissue abnormalities.

Even though the CT exam is very fast, motion from breathing or body movement during the exam may result in blurring of the images.

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