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The radiology information resource for patients

Computed Tomography (CT) - Chest

What is CT Scanning of the Chest?

CT scanning—sometimes called CAT scanning—is a noninvasive medical test that helps physicians diagnose and treat medical conditions.

CT scanning combines special x-ray equipment with sophisticated computers to produce multiple images or pictures of the inside of the body. These cross-sectional images of the area being studied can then be examined on a computer monitor, printed or transferred to a CD.

CT scans of internal organs, bones, soft tissue and blood vessels provide greater clarity and reveal more details than regular x-ray exams.

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 image quality to detect many lung diseases and abnormalities using up to 65 percent less ionizing radiation than a conventional chest CT scan. This is especially true for detecting and following lung cancer. Other diseases, such as the detection of pulmonary embolism and interstitial lung disease may not be appropriate for low-dose chest CT. 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?

CT of the chest is used to:

- further examine abnormalities found on conventional chest x-rays.
- help diagnose the cause 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 blood vessels, lungs, ribs and spine.
- further evaluate abnormalities of the chest found on fetal ultrasound examinations.

Chest CT can demonstrate various lung disorders, such as:

- lung cancer.
- old or new pneumonia.
- tuberculosis.
- emphysema.
- bronchiectasis.
- inflammation or other diseases of the pleura, which covers the lungs.
- diffuse interstitial lung disease.
- congenital abnormalities.

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 numerous, thinner CT images. See the CT Angiography (CTA) page www.RadiologyInfo.org/en/info.cfm?pg=angioct for more information.

Potential Lung Cancer Screening Tool:

Because CT scans are able to detect even very small nodules in the lung, chest CT is especially effective for diagnosing lung cancer at its earliest, most curable stage. As a result, two major clinical trials are underway to determine if CT scanning is helpful at reducing deaths from the disease and to study the benefits associated with the early detection of lung cancer by CT screening.

Depending on the results of this research, low-dose chest CT may become a screening tool for detecting lung cancer in current and former smokers as well as other individuals who have a high risk of developing lung cancer.

How should I prepare?

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

Metal objects including jewelry, eyeglasses, dentures and hairpins may affect the CT images and should be left at home or removed 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 not to eat or drink anything for several hours beforehand, especially if a contrast material will be used in your exam. You should inform your physician of any medications you are taking and if you have any allergies. If you have a known allergy to contrast material, or "dye," your doctor may prescribe medications to reduce the risk of an allergic reaction.

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

Women should always inform their physician and the CT technologist if there is any possibility that they are pregnant. See the Safety page (www.RadiologyInfo.org/en/safety/) for more information about pregnancy and x-rays.

What does the equipment look like?

The CT scanner is typically a large, box like machine with a hole, or short tunnel, in the center. You will lie on a narrow examination table that slides into and out of this 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 room, where the technologist operates the scanner and monitors your examination.

How does the procedure work?

In many ways CT scanning works very much like other x-ray examinations. X-rays are a form of radiation—like light or radio waves—that can be directed at the body. Different body parts absorb the x-rays in varying degrees.

In a conventional x-ray exam, a small burst of radiation is aimed at and passes through the body, recording an image on photographic film or a special image recording plate. Bones appear white on the x-ray; soft tissue shows up in shades of gray and air appears black.

With CT scanning, numerous x-ray beams and a set of electronic x-ray detectors rotate around you, measuring the amount of radiation being absorbed throughout your body. At the same time, the examination table is moving through the scanner, 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, which are then displayed on a monitor. This technique is called helical or spiral CT.

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 new CT scanners to obtain multiple slices in a single rotation. These scanners, called "multislice CT" or "multidetector CT," allow thinner slices to be obtained in a shorter period of time, resulting in more detail and additional view capabilities.

Modern CT scanners are so fast that they can scan through large sections of the body in just a few seconds. Such speed is beneficial for all patients but especially children, the elderly and critically ill.

For children, the CT scanner technique will be adjusted 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 actual patient 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)
- 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 examination table, usually lying flat on your back or possibly on your side or on your stomach. Straps and pillows may be used to help you maintain the correct position and to hold still during the exam.

For children who cannot hold still for the examination, sedation may be needed. Motion will 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.

You may be asked to hold your breath during the scanning. Any motion, whether breathing or body movements, can lead to artifacts on the images. This is similar to the blurring seen on a photograph taken of a moving object.

When the examination is completed, 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 is usually completed within 30 minutes.

What will I experience during and after the procedure?

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

Though the scanning itself causes no pain, there may be some discomfort from having to remain still for several minutes. If you have a hard time staying still, are claustrophobic or have chronic pain, you may find a CT exam to be stressful. The technologist or nurse, under the direction of a physician, may offer you a mild sedative to help you tolerate the CT scanning procedure.

If an intravenous contrast material is used, you will feel a slight pin prick when the needle is inserted into your vein. You may have a warm, flushed sensation during the injection of the contrast materials and a metallic taste in your mouth that lasts for a few minutes. Some patients may experience a sensation like they have to urinate but this subsides quickly.

When you enter the CT scanner, special lights may be used to ensure that you are properly positioned. With modern CT scanners, you will hear only slight buzzing, clicking and whirring sounds as the CT scanner revolves around you during the imaging process.

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

With pediatric patients, a parent may be allowed in the room but will be required to wear a lead apron to minimize radiation exposure.

After a CT exam, you can return to your normal activities. If you received contrast material, you may be given special instructions.

Who interprets the results and how do I get them?

A physician, usually a radiologist with expertise in supervising and interpreting radiology examinations, will analyze the images and send a signed report to your primary care physician or the physician who referred you for the exam, who will discuss the results with you.

What are the benefits vs. risks?

Benefits

- CT is fast, which is important for patients who have trouble holding their breath.
- 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 usually 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 from a chest CT for an adult is about 7 mSv, which is about the same as the average person receives from background radiation in two years. The effective radiation dose from a low-dose chest CT is about 1.5 mSv, which is about the same as the average person receives from background radiation within six months. See the Safety page

(www.RadiologyInfo.org/en/safety/) for more information about radiation dose.

- Women should always inform their physician and x-ray or CT technologist if there is any possibility that they are pregnant. See the Safety page (www.RadiologyInfo.org/en/safety/) 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 baby.
- Nursing mothers should wait for 24 hours after contrast material injection before resuming breast-feeding.
- 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.
- Because children are more sensitive to radiation, they should have a CT study only if it is essential for making a diagnosis and should not have repeated CT studies unless absolutely necessary.

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 for the moving table which is usually about 450 pounds.

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

Additional Information and Resources

RadiologyInfo

Radiation Therapy for Lung Cancer:
www.RadiologyInfo.org/en/info.cfm?pg=lungcancer

Needle Biopsy of Lung (Chest) Nodules:
www.RadiologyInfo.org/en/info.cfm?pg=nlungbiop

RTAnswers.org

Radiation Therapy for Lung Cancer:
www.rtanswers.org/treatmentinformation/cancertypes/lung/index.aspx

Please visit the RadiologyInfo Web site at **http://www.radiologyinfo.org** to view or download the latest information.

Note: Images may be shown for illustrative purposes. Do not attempt to draw conclusions or make diagnoses by comparing these images to other medical images, particularly your own. Only qualified physicians should interpret images; the radiologist is the physician expert trained in medical imaging.

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