



What is CT Scanning?

CT (computed tomography), sometimes called CAT scan, uses special x-ray equipment to obtain image data from different angles around the body and then uses computer processing of the information to show a cross-section of body tissues and organs.

CT imaging is particularly useful because it can show several types of tissue—lung, bone, soft tissue and blood vessels—with great clarity. Using specialized equipment and expertise to create and interpret CT scans of the body, radiologists can more easily diagnose problems such as cancers, cardiovascular disease, infectious disease, trauma and musculoskeletal disorders.

What are some common uses of the procedure?

Because it provides detailed, cross-sectional views of all types of tissue, CT is one of the best tools for studying the chest and abdomen. It is often the preferred method for diagnosing many different cancers, including lung, liver and pancreatic cancer, since the image allows a physician to confirm the presence of a tumor and measure its size, precise location and the extent of the tumor's involvement with other nearby tissue. CT examinations are often used to plan and properly administer radiation treatments for tumors, to guide biopsies and other minimally invasive procedures and to plan surgery and determine surgical respectability. CT can clearly show even very small bones as well as surrounding tissues such as muscle and blood vessels. This makes it invaluable in diagnosing and treating spinal problems and injuries to the hands, feet and other skeletal structures. CT images can also be used to measure bone mineral density for the detection of osteoporosis. In cases of trauma CT can quickly identify injuries to the liver, spleen, kidneys or other internal organs. Many dedicated shock-trauma centers have a CT scanner in the emergency room. CT can also play a significant role in the detection, diagnosis and treatment of vascular diseases that can lead to stroke, kidney failure or even death.

How should I prepare for the CAT scan?

You should wear comfortable, loose-fitting clothing for your CT exam. Metal objects can affect the image, so avoid clothing with zippers and snaps. You may also be asked to remove hairpins, jewelry, eyeglasses, hearing aids and any removable dental work, depending on the part of the body that is being scanned. You may be asked not to eat or drink anything for one or more hours before the exam. Women should always inform their doctor or x-ray technologist if there is any possibility that they are pregnant.

What does the equipment look like?

The CT scanner is a large, square machine with a hole in the center. The patient lies still on a table that can move up or down and slide into and out from the center of the hole. Within the machine an x-ray tube on a rotating gantry moves around the patient's body to produce the

images, making clicking and whirring noises as the table moves. Though the technologist will be able to see and speak to you, you will be alone in the room during the exam. An example of the radiography equipment that may be used is shown above.

How does the procedure work?

In many ways CT scanning works very much like other x-ray examinations. Very small, controlled amounts of x-ray radiation are passed through the body and different tissues absorb radiation at different rates. With plain radiology, an image of the inside of the body is captured when special film is exposed to the absorbed x-rays. With CT the film is replaced by an array of detectors that measure the x-ray profile. Inside the CT scanner is a rotating gantry that has an x-ray tube mounted on one side and an arc-shaped detector mounted on the opposite side. An x-ray beam is emitted in a fan shape as the rotating frame spins the x-ray tube and detector around the patient. Each time the x-ray tube and detector make a 360-degree rotation and the x-ray passes through the patient's body, the image of a thin section is acquired. During each rotation the detector records about 1,000 images (profiles) of the expanded x-ray beam. Each profile is then reconstructed by a dedicated computer into a two-dimensional image of the section that was scanned. Multiple computers are typically used to control the entire CT system. You might think of it as a loaf of bread cut into thin slices. When the image slices are reassembled by computer, the result is a very detailed, multidimensional view of the body's interior. A relatively new technique, spiral (helical) CT has improved the accuracy of CT for many diseases. A new vascular imaging technique, called spiral CT angiography, is noninvasive and less expensive than conventional angiography and allows doctors to see blood vessels without the need for more invasive procedures.

The term "spiral CT" comes from the shape of the path taken by the x-ray beam during scanning. The examination table advances at a constant rate through the scanner gantry while the x-ray tube rotates continuously around the patient, tracing a spiral path through the patient. This spiral path gathers continuous data with no gaps between images.

With spiral CT, refinements in detector technology support faster, higher-quality image acquisition with less radiation exposure. The current spiral CT scans are called multidetector CT and are most commonly four- or 16-slice systems. CT scanners with 64 detectors are now available. These instruments should provide either faster scanning or higher resolution images. Using 16-slice scanner systems the radiologist can acquire 32 image slices per second. A spiral scan can usually be obtained during a single breath hold. This allows scanning of the chest or abdomen in 10 seconds or less. Such speed is beneficial in all patients but especially in elderly, pediatric or critically ill patients, populations in whom the length of scanning was often problematic. The multidetector CT also allows applications like CT angiography to be more successful.

With conventional CT, small lesions may go undetected when a patient breathes differently on consecutive scans because lesions may be missed by unequal spacing between scans. The speed of spiral scanning and a single breath hold increase the rate of lesion detection.

How is the CAT scan performed?

The technologist begins by positioning the patient on the CT table. The patient's body may be supported by pillows to help hold it still and in the proper position during the scan. As the study proceeds, the table will move slowly into the CT scanner. Depending on the area of the body being examined, the increments of movement may be so small that they are almost undetectable or large enough that the patient feels the sensation of motion. A CT examination often requires the use of different contrast materials to enhance the visibility of certain tissues or blood vessels. The contrast material may be swallowed, injected through an IV directly into the blood stream or

administered by enema, depending on the type of examination. Before administering the contrast material, the radiologist or technologist may ask whether the patient has any allergies, especially to medications or iodine, and whether the patient has a history of diabetes, asthma, a heart condition, kidney problems or thyroid conditions. These conditions may indicate a higher risk of reaction to the contrast material or potential problems eliminating the material from the patient's system after the exam. A CT examination usually takes five minutes to half an hour. When the exam is over the patient may be asked to wait until the images are examined to determine if more images are needed.

What will I experience during the procedure?

CT scanning causes no pain, and with spiral CT the need to lie still for any length of time is reduced. For different parts of the body the patient preparation will be different. You may be asked to swallow either water or a positive contrast material, a liquid that allows the radiologist to better see the stomach, small bowel and colon. Some patients find the taste of the contrast material mildly unpleasant but most can easily tolerate it. Your exam may require the administration of the material by enema if the colon is the focus of the study. You will experience a sense of abdominal fullness and may feel an increasing need to expel the liquid. Be patient; the mild discomfort will not last long.

A contrast material is commonly injected into a vein to better define the blood vessels and kidneys and to accentuate the appearance between normal and abnormal tissue in organs like the liver and spleen. Some people report feeling a flush of heat and sometimes a metallic taste in the back of the mouth. These sensations usually disappear within a minute or two. Some people experience a mild itching sensation. If it persists or is accompanied by hives (small bumps on the skin), the itch can be treated easily with medication. In very rare cases, a patient may become short of breath or experience swelling in the throat or other parts of the body. These can be indications of a more serious reaction to the contrast material that should be treated promptly, so tell the technologist immediately if you experience these symptoms. Fortunately, with the safety of the newest contrast materials, these adverse effects are very rare. You will be alone in the room during the scan; however, the technologist can see, hear and speak with you at all times. For pediatric patients, a parent may be allowed in the room with the patient to alleviate fear but will be required to wear a lead apron to prevent radiation exposure.

What are the limitations of CT?

Very fine soft-tissue details in areas such as the knee or shoulder can be more readily and clearly seen with magnetic resonance imaging (MRI). The exam is not generally indicated for pregnant women.

Who interprets the results and how do I get them?

A radiologist, who is a physician experienced in CT and other radiology examinations, will analyze the images and send a signed report with his or her interpretation to the patient's personal physician. The personal physician's office will inform the patient on how to obtain their results. New technology also allows for distribution of diagnostic reports and referral images over the Internet at some facilities.

What are the benefits vs. risks?

Benefits

Unlike other imaging methods, CT scanning offers detailed views of many types of tissue including the lungs, bones, soft tissues and blood vessels.

CT scanning is painless, noninvasive and accurate.

CT examinations are fast and simple. For example, in trauma cases they can reveal internal injuries and bleeding quickly enough to help save lives.

Diagnosis made with the assistance of CT can eliminate the need for invasive exploratory surgery and surgical biopsy.

CT scanning can identify normal and abnormal structures, making it a useful tool to guide radiotherapy, needle biopsies and other minimally invasive procedures.

CT has been shown to be a cost-effective imaging tool for a wide range of clinical problems.

Risks

CT does involve exposure to radiation in the form of x-rays, but the benefit of an accurate diagnosis far outweighs the risk. The effective radiation dose from this procedure is about 10 mSv, which is about the same as the average person receives from background radiation in three years. *See the Safety page for more information about radiation dose.*

Women should always inform their doctor or x-ray technologist if there is any possibility that they are pregnant. *See the Safety page for more information about pregnancy and x-rays.*

Nursing mothers should wait 24 hours after contrast injection before resuming breast feeding.

The risk of serious allergic reaction to iodine-containing contrast material is rare, and radiology departments are well equipped to deal with them.

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