

Computed Tomography (CT) - Head

This procedure is reviewed by a physician with expertise in the area presented and is further reviewed by committees from the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), comprising physicians with expertise in several radiologic areas.

What is CT Scanning of the Head?

Computed tomography (CT), sometimes called CAT scan, uses special x-ray equipment to obtain many images from different angles and then join them together to show a cross-section of body tissues and organs. CT scanning provides more detailed information on head injuries, stroke, brain tumors and other brain diseases than do regular radiographs (plain x-ray films). It also can show bone, soft tissues and blood vessels in the same images. CT of the head and brain is a patient-friendly exam that involves radiation exposure.

What are some common uses of the procedure?

- Detection of bleeding, brain damage and skull fractures in patients with head injuries.
- Detecting a blood clot or bleeding within the brain shortly after a patient exhibits symptoms of a stroke.
- Detection of stroke, especially with a new technique called Perfusion CT.
- Evaluation of the extent of bone and soft tissue damage in patients with facial trauma, and planning surgical reconstruction.
- Detection of bleeding in a patient with a sudden severe headache who may have a ruptured or leaking aneurysm.
- Detection of most brain tumors.
- Diagnosing diseases of the temporal bone on the side of the skull, which may be causing hearing problems.
- Detection of enlarged brain cavities (ventricles) in patients with hydrocephalus.
- Determining whether inflammation or other changes are present in the paranasal sinuses.

- Planning radiation therapy for cancer of the brain or other tissues.
- Guiding the passage of a needle used to obtain a tissue sample (biopsy) from the brain.
- Non-invasive assessment of aneurysms or arteriovenous malformations through a technique called CT angiography.
- Detecting diseases or malformations of the skull.
- Three-dimensional imaging of the skull and brain structures.

How should I prepare for the CAT scan?

You should wear comfortable, loose-fitting clothing for your CT exam. Anything that might interfere with imaging of the head—such as earrings, eyeglasses, dentures, dental implants or hairpins—should be removed.

No special preparation is needed for a CT scan of the head unless you are to receive a contrast material—a substance that highlights the brain and its blood vessels and makes abnormalities easier to see. If the radiologist believes that an intravenous (IV) injection of a contrast material will be helpful, you may be asked in advance whether you have had allergies in the past or have ever had a serious reaction to medication. CT scan contrast materials contain iodine, which can cause a reaction in persons who are allergic. If you have known allergies to other medications it may raise the possibility that you might have an allergic reaction to the contrast material. The radiologist also should know if you have asthma, multiple myeloma or any disorder of the heart, kidneys or thyroid gland, or if you have diabetes—particularly if you are taking Glucophage. Typically you will be asked to sign an informed consent form before having CT with injection of a contrast material.

Women should always inform their doctor or x-ray technologist if there is any possibility that they are

pregnant. In some cases an alternate study will be performed to reduce or eliminate the radiation exposure to the fetus.

What does the equipment look like?

The CT scanner is a large, square machine with a hole in the center, something like a doughnut. The patient lies still on a table that can move up or down and slide into and out of the center of the hole. Within the machine, an x-ray tube on a rotating gantry (or frame) moves around the patient's body to produce the images, making clicking and whirring noises as the arm 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 below.



How does the procedure work?

Unlike conventional x-rays, which produce pictures of the shadows cast by body structures of different density, CT scanning uses x-rays in a much different way. In CT of the head, numerous x-ray beams are passed through the skull and brain at different angles, and special sensors measure the amount of radiation absorbed by different tissues (and lesions such as a bleeding tumor). As you lie still, the scanner parts revolve around you (although you cannot see this happen), emitting and recording x-ray beams from as many as a thousand points on the circle. A special computer program then uses the differences in x-ray absorption to form cross-sectional images, or "slices" of the head and brain. These slices are called tomograms, hence the name "computed tomography."

How is the CAT scan performed?

CT scanning of the head may be performed in the hospital or at an outpatient radiology center, but in either case your doctor must give you a written referral with the reason why the study should be performed. You will lie on a table that is guided into the center of the scanner and you will be asked to lie very still.

As stated earlier, some patients will require an injection of a contrast material to enhance the visibility of certain tissues or blood vessels. A small needle connected to an intravenous line is placed in an arm or hand vein. The contrast material will be injected through this line.

Depending on the number of images needed, a CT exam of the head and brain can take two to 20 minutes. When it is completed you will be asked to wait until the technologist examines the images to determine if more are needed.

What will I experience during the procedure?

When you enter the scanner, special lights may be turned on to ensure correct positioning. Some types of exam (such as a scan of the sinuses) call for a special head holder that uses soft straps to keep the head and neck in proper alignment. In some cases you will lie on your stomach; in others on your back. The patient and technologist can talk at any time via an intercom.

CT itself causes no pain. Usually the CT scanning takes many seconds or just a few minutes to perform. If contrast material is injected you may have a warm, flushed sensation during the injection. You may also experience a metallic taste in your mouth that lasts for about two minutes. Occasionally a patient will develop itching and hives for up to a few hours after the injection; this can be relieved by medication. If you develop light-headedness or difficulty breathing, it may indicate a more severe allergic reaction—a physician or nurse will be present nearby to assist you.

Because CT uses x-rays, you may not have a relative or friend in the CT room during the exam.

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 provide a signed report with his or her interpretation to the patient's referring physician. The patient receives the results from the referring physician who ordered the

test. New technology also allows for distribution of diagnostic reports and referral images over the Internet at many facilities.

What are the benefits vs. risks?

Benefits

- CT of the head is now widely available and is performed in a relatively short time, at a reasonable cost—especially when compared to MR imaging.
- The exam shows some changes in bone better than any other imaging method.
- It readily detects bleeding.
- The exam is usually used as an initial study for stroke detection.
- It provides detailed images of bone, soft tissue and blood vessels.
- CT is the method of choice for rapidly screening trauma victims to detect internal bleeding or other life-threatening conditions.
- CT Angiography depicts brain blood vessels, revealing aneurysms and occlusion.

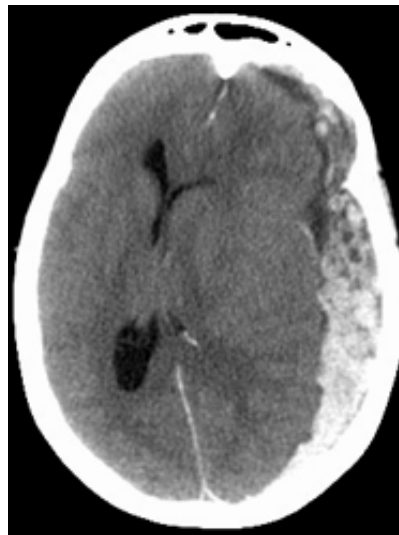
Risks

- 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 2 mSv, which is about the same as the average person receives from background radiation in the general environment over a period of eight months.
- Women should always inform their doctor or x-ray technologist if there is any possibility that they are pregnant.
- 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 personnel working at CT units are well equipped to deal with them.

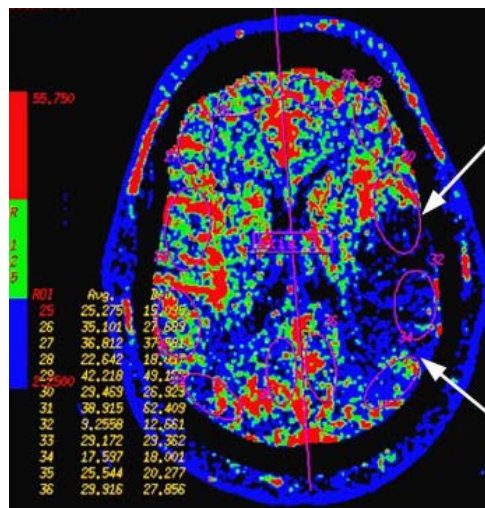
What are the limitations of CT Scanning of the Head?

Compared to MR imaging, the precise details of soft tissue (particularly the brain) are less visible on CT scans. CT is not sensitive in detecting inflammation of the meninges—the membranes covering the brain.

Compared to conventional angiography, computed tomography angiography (CTA) may, in some cases, not be as sensitive in the detection of aneurysms and arteriovenous malformations of the brain.



Sample image: Recent bleeding (subdural hematoma) in an injured patient is seen as a bright mass that is pushing the brain to the other side.



Sample image: Perfusion CT in a patient with stroke demonstrates the part of the brain with severely decreased blood flow (arrows).

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