CT Perfusion Imaging of the Head

Computed tomography (CT) perfusion of the head uses special x-ray equipment to show which areas of the brain are adequately supplied with blood (perfused) and provides detailed information about blood flow to the brain. CT perfusion is fast, painless, noninvasive and accurate. It's a useful technique for measuring blood flow to the brain, which may be important for treating stroke, brain blood vessel disease and brain tumors.

Tell your doctor if there's a possibility you are pregnant and discuss any recent illnesses, medical conditions, medications you're 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 12 hours prior to your exam. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.

What is CT Perfusion of the Head?

Computed tomography (CT) (http://www.radiologyinfo.org) perfusion imaging shows which areas of the brain are adequately supplied or perfused with blood and provides detailed information on delivery of blood or blood flow to the brain.

CT perfusion 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.

What are some common uses of the procedure?

CT perfusion is typically used to:

- evaluate acute stroke (http://www.radiologyinfo.org) .
- assist with selecting patients for thrombolytic therapy (http://www.radiologyinfo.org) following a stroke by identifying brain tissue at risk of infarction (http://www.radiologyinfo.org) or permanent injury by lack of an adequate blood supply.
- evaluate vasospasm (http://www.radiologyinfo.org) , a sudden blood vessel constriction that may arise from a subarachnoid hemorrhage (http://www.radiologyinfo.org) , in which bleeding occurs in the space between the two membranes surrounding the brain, known as the dura mater and arachnoid membrane.
- assess patients who are candidates for surgical or neuroendovascular treatments (http://www.radiologyinfo.org) . The technique employs special catheters (long, thin tubes), some containing special instruments, that can be manipulated into the area of vessel blockage to dissolve or dislodge a blood clot.
- diagnose and assess treatment response in patients with a variety of brain tumors.

How should I prepare?

Wear comfortable, loose-fitting clothing to your exam. You may need to change into a gown for 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. Some CT exams will require you to remove hearing aids and removable dental work. Women will need to remove bras containing metal underwire. You may need to remove any piercings, if possible.

Your doctor may instruct you to not eat or drink anything for a few hours before your exam if it will use contrast material (http://www.radiologyinfo.org) . Tell your doctor about 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 well before the date of your exam.

Also tell your doctor about 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.

The radiologist also should know if you have asthma, multiple myeloma (http://www.radiologyinfo.org) or any disorder of the heart, kidneys (http://www.radiologyinfo.org) or thyroid gland (http://www.radiologyinfo.org) , or if you have diabetes (http://www.radiologyinfo.org) —particularly if you are taking Glucophage (http://www.radiologyinfo.org) . Any of these conditions or medications may affect the safety for the administration of contrast material used for this special CT exam.

Women should always inform their physician and the CT technologist if there is any possibility that they may be pregnant. *See the CT Safety During Pregnancy (https://www.radiologyinfo.org/en/info/safety-ct-pregnancy) page for more information.*

What does the equipment look like?

CT perfusion is performed on a CT scanner.

The CT scanner is typically a large, donut-shaped machine with a short tunnel in the center. You will lie on a narrow 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 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.

A conventional x-ray exam directs a small amount of radiation through the body part under examination. 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. A special computer program processes this large volume of data to create two-dimensional cross-sectional images of your body. The system displays the images on a computer monitor. CT imaging is sometimes compared to looking into a loaf of bread by cutting the loaf into thin slices. When the computer software reassembles the image slices, the result is a very detailed multidimensional view of the body's interior.

Nearly all CT scanners can obtain multiple slices in a single rotation. These multi-slice (multidetector) CT scanners obtain thinner

slices in less time. This results in more detail.

Modern CT scanners can image large sections of the body in just a few seconds, and even faster in small children. Such speed is beneficial for all patients. Speed is 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.

How is the procedure performed?

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

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 for the actual CT scan. Depending on the type of CT scan, the machine may make several passes.

The contrast material will then be injected through an intravenous line (IV) while additional scans are obtained. In most cases, the contrast material is injected by a special machine attached to the IV line, which ensures precise delivery of the contrast material at a rate and time period prescribed by the radiologist. Such accuracy in injection is required for a successful perfusion CT scan.

The technologist may ask you to hold your breath during the scanning. Any motion, including breathing and body movements, can lead to artifacts (http://www.radiologyinfo.org) 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, the technologist will ask you to wait until they verify that the images are of high enough quality for accurate interpretation by the radiologist.

A CT perfusion scan of the head is usually completed in 25 minutes.

What will I experience during and after the procedure?

CT exams are generally painless, fast, and easy. Multidetector CT reduces the amount of time that the patient needs to lie still.

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 some medication to help you tolerate the CT scanning procedure.

However, the very open design of a modern CT scanner rarely causes a claustrophobic sensation.

When the intravenous contrast material is injected, you will feel a pinprick as the needle is inserted into your vein, which is usually located in your arm, near the crease in your elbow.

You may have a warm, flushed sensation during the injection of the contrast material 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, you may see special light lines projected onto your body. These lines help ensure that you are in the correct position on the exam table. 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 your intravenous line. They will cover the tiny hole made by the needle with a small dressing. You can return to your normal activities immediately.

Who interprets the results and how do I get them?

A radiologist (https://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.

What are the benefits vs. risks?

Benefits

- CT perfusion is a useful technique for measuring perfusion in the brain. Measuring perfusion may be important for treating stroke, other blood vessel diseases of the brain and brain tumors.
- 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 exams 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 can be performed if you have an implanted medical device of any kind.
- 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 exam.
- The x-rays used for CT scanning should have no immediate side effects.

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 involved with CT scanning.
- The effective radiation dose for this procedure varies. *See the Radiation Dose (https://www.radiologyinfo.org/en/info/safety-xray) page for more information.*
- Every effort is made to use the lowest radiation dose possible, while not sacrificing the quality of the CT images necessary to effectively diagnose a disease process. Nearly all CT scanners now have special computer programs that help to increase image quality at lower radiation doses.
- Women should always tell their doctor and x-ray or CT technologist if there is any chance they are pregnant. *See the Radiation Safety (https://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 baby. This risk is, however, minimal with head CT scanning, as the x-ray beam is confined to the head, far away from the abdominal cavity where the baby lies.
- Nursing mothers should wait for 24 hours after contrast material injection before resuming breastfeeding.
- The risk of serious allergic reaction to contrast materials that contain iodine is extremely rare. Radiology departments are well-equipped to deal with any allergic reaction.

What are the limitations of CT Perfusion of the Head?

A person who is very large may not fit into the opening of a conventional CT scanner. Or, they may be over the weight limit—

usually 450 pounds—for the moving table.

External or implanted metallic objects of the head, such as earrings, aneurysm coils, surgical clips and other materials may cause image artifacts (inaccurate image information created by errors of CT image reconstruction). These image artifacts can degrade the quality of CT perfusion imaging.

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