



Computed Tomography (CT) - Angiography

What is CT angiography?

Angiography is a minimally invasive medical test that helps physicians diagnose and treat medical conditions. Angiography uses one of three imaging technologies and, in some cases, a contrast material to produce pictures of major blood vessels throughout the body.

Angiography is performed using:

- x-rays with catheters
- computed tomography (CT)
- magnetic resonance imaging (MRI)

CT imaging uses special x-ray equipment to produce multiple images and a computer to join them together in multidimensional views. In CT angiography (CTA), a contrast material (also known as "dye") is injected into a vein to produce detailed images of both blood vessels and tissues.

What are some common uses of the procedure?

CT angiography is used to examine blood vessels in key areas of the body, including the:

- brain
- abdomen (such as the kidneys and liver)
- pelvis
- legs
- lungs
- heart
- neck



Physicians use the procedure to:

- identify abnormalities, such as aneurysms, in the aorta, both in the chest and abdomen, or in other arteries.
- detect atherosclerosis disease in the carotid artery of the neck, which may limit blood flow to the brain and cause a stroke.
- identify a small aneurysm or arteriovenous malformation inside the brain.

- detect atherosclerotic disease that has narrowed the arteries to the legs and help prepare for endovascular intervention or surgery.
- detect disease in the arteries to the kidneys or visualize blood flow to help prepare for a kidney transplant.
- guide interventional radiologists and surgeons making repairs to diseased blood vessels, such as implanting stents or evaluating a stent after implantation.
- detect injury to one or more arteries in the neck, chest, abdomen, pelvis or extremities in trauma patients.
- evaluate arteries feeding a tumor prior to surgery or other procedures such as chemoembolization or selective internal radiation therapy.
- identify dissection or splitting in the aorta in the chest or abdomen or its major branches.
- show the extent and severity of atherosclerosis in the coronary arteries and plan for a surgical operation, such as a coronary bypass and stenting.
- sample blood from specific veins in the body to detect any endocrine disease.
- examine pulmonary arteries in the lungs to detect pulmonary embolism (blood clots from leg veins).
- look at congenital abnormalities in blood vessels, especially arteries in children (e.g., malformations in the heart due to birth defects).
- evaluate obstructions of vessels (e.g., blood clots in the lungs).

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.

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 all 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 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 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.

If you are breastfeeding at the time of the exam, you should ask your radiologist how to proceed. It may help to pump breast milk ahead of time and keep it on hand for use after contrast material has cleared from your body, about 24 hours after the test.

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 control 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 amount 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, such as organs like the heart or liver, 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, and even faster in small children. Such speed is beneficial for all patients but especially children, the elderly and critically ill.

When a contrast material is introduced to the bloodstream during the procedure, it clearly defines the blood vessels being examined by making them appear bright white.

How is the procedure performed?

This examination is usually done on an outpatient basis.

The technologist begins by positioning you on the CT examination table, usually



lying flat on your back or less commonly, 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. Depending on the part of the body being scanned, you may be asked to keep your hands over your head.



A nurse or technologist will insert an intravenous (IV) catheter, also called a line, into a small vein usually in your arm or hand.

A small amount of contrast material ("dye") may initially be injected through the IV to determine how long it will take for the full amount to reach the area under examination. During scanning, the table will then move to the start point and then move relatively rapidly through the opening in the machine as the actual CT scanning is performed. An automatic injection machine connected to the IV is usually used and will inject contrast material at a controlled rate both prior to and during scanning. In some cases, especially in children, the injection is given by hand with a syringe by a person in the CT room, often a nurse.

In exams of the coronary arteries or aorta in the chest, electrocardiogram (EKG) leads are usually placed to record heart rate and rhythm during scanning. Your heart rate may be slowed with drugs called beta blockers prior to scanning. If heart rate medication is given, you will be monitored during and after the procedure. Following scanning, you should have no side effects from the beta blocker medication. You will be able to leave the department unassisted and drive yourself home.

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.

Occasionally, sedation is needed for children to keep them still during the scanning. This usually needs to be prearranged when the CT scan is scheduled as there will be special instructions. For example, eating and drinking must be stopped prior to the sedation procedure, and arrangements should be made for monitoring during recovery following the scan.

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.

Your intravenous line will be removed.

With modern equipment, the CT scanning only takes from less than one second in infants to 20 seconds to acquire the appropriate images. Your actual time in the scanner room will be longer as the technologist will have to position you on the table, check or place an IV line, do preliminary imaging to verify the beginning and end points of the exam, and enter the injection and acquisition sequence into a computer.

CT angiography may be performed in children. Since children are more sensitive to radiation than adults, appropriate utilization and age-appropriate CT techniques should be used.

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 some medication to help you tolerate the CT scanning procedure.

If an intravenous contrast material is used, you will feel a 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 light lines may be seen on your body and are 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, unless there are special circumstances. However, the technologist will always 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.

Follow-up examinations are often necessary, and your doctor will explain the exact reason why another exam is requested. Sometimes a follow-up exam is done because a suspicious or questionable finding needs clarification with additional views or a special imaging technique. A follow-up examination may be necessary so that any change in a known abnormality can be detected over time. Follow-up examinations are sometimes the best way to see if treatment is working or if an abnormality is stable over time.

What are the benefits vs. risks?

Benefits

- Angiography may eliminate the need for surgery. If surgery remains necessary, it can be performed more accurately.
- CT angiography is able to detect narrowing or obstruction of blood vessels in time for corrective therapy to be done.
- CT angiography may give more precise anatomical detail than magnetic resonance imaging (MRI), particularly in small blood vessels.
- Many patients can undergo CT angiography instead of a conventional catheter angiogram (catheterization).

- Compared to catheter angiography, which involves placing a catheter (plastic tube) and injecting contrast material into a large artery or vein, and may require sedation or general anesthesia, CT angiography is a much less invasive and more patient-friendly procedure.
- This procedure is a useful way of screening for arterial and venous disease, as well as structural abnormalities of the heart because it is safer and much less time-consuming than catheter angiography and is a cost-effective procedure. There is also less discomfort because contrast material is injected into an arm vein rather than into a catheter inserted into a large artery or vein in the groin.
- No radiation remains in a patient's body after a CT examination.
- X-rays used in CT scans usually 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.
- If you have a history of allergy to x-ray contrast material, your radiologist may advise that you take special medication, such as a steroid, for 24 hours before CT angiography to lessen the risk of allergic reaction. Another option is to undergo a different exam that does not call for contrast material injection.
- If a large amount of x-ray contrast material leaks out from the vessel being injected and spreads under the skin where the IV is placed, skin damage or damage to blood vessels and nerves, though unlikely, can result. If you feel any pain in this area during contrast material injection, you should immediately inform the technologist.
- 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.
- 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.

What are the limitations of CT Angiography?

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.

CT angiography should be avoided in patients with a previous reaction to contrast material, advanced kidney disease or severe diabetes, because x-ray contrast material can further harm kidney function.

Disclaimer

This information is copied from the RadiologyInfo Web site (<http://www.radiologyinfo.org>) which is dedicated to providing the highest quality information. To ensure that, each section is reviewed by a physician with expertise in the area presented. All information contained in the Web site is further reviewed by an ACR (American College of Radiology) - RSNA (Radiological Society of North America) committee, comprising physicians with expertise in several radiologic areas.

However, it is not possible to assure that this Web site contains complete, up-to-date information on any particular subject.

Therefore, ACR and RSNA make no representations or warranties about the suitability of this information for use for any particular purpose. All information is provided "as is" without express or implied warranty.

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.

Copyright

This material is copyrighted by either the Radiological Society of North America (RSNA), 820 Jorie Boulevard, Oak Brook, IL 60523-2251 or the American College of Radiology (ACR), 1891 Preston White Drive, Reston, VA 20191-4397. Commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is prohibited.

Copyright © 2012 Radiological Society of North America, Inc.