CT Angiography

This information 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 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), computed tomography using a contrast material produces 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
- kidneys
- pelvis
- legs
- lungs
- heart
- neck
- abdomen

Physicians use the procedure to:

- identify disease and aneurysms in the aorta, both in the chest and abdomen, or in other major blood vessels.
- detect atherosclerotic 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.
- indicate 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 stent or evaluating a stent after implantation.
- detect injury to one of 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.
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- 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).

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, 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 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.

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 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 digital 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.

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 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.

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

A small dose of contrast material may be injected through the IV to determine how long it takes to reach the area under study. During scanning, the table will then move to the start point and then move relatively rapidly through the gantry opening in the machine as the actual CT scanning is performed. An automatic injection machine connected to the IV will inject contrast material at a controlled rate both prior to and during scanning.

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 beta blocker drugs prior to scanning. If heart rate medication is given, it will be monitored during and after the procedure.

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.

Your intravenous line will be removed.

With modern equipment, the CT scanning only takes between 5 and 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 study, and enter the injection and acquisition sequence into a computer.

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 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 will 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

- Angiography may eliminate the need for surgery. If surgery remains necessary, it can be performed more accurately.
- CT angiography is able to detect narrowing of blood vessels in time for corrective therapy to be done.
- CT angiography gives more precise anatomical detail of blood vessels than magnetic resonance imaging (MRI).
- Many patients can undergo CT angiography instead of a conventional catheter angiogram.
- Compared to catheter angiography, which involves placing a catheter (plastic tube) and injecting contrast material into a large artery or vein, CT angiography is a much less invasive and more patient-friendly procedure.

- This procedure is a useful way of screening for arterial disease 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 large artery in the groin.
- No radiation remains in a patient's body after a CT examination.
- X-rays used in CT scans usually have no 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 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.
- Nursing mothers should wait for 24 hours after intravenous 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 for the moving table.

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

If a patient's heart is not functioning normally, or if there are multiple blocked blood vessels, CT angiograms may be hard to interpret. CT angiograms are not yet as reliable as selective catheter injections (performed after puncture of the artery in the groin) in imaging small tortuous arteries, particularly coronary arteries in the rapidly moving heart.