

## Computed Tomography Angiography (CTA)

*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 Angiography?

CT (computed tomography) angiography (CTA) is an examination that uses x-rays to visualize blood flow in arterial and venous vessels throughout the body, from arteries serving the brain to those bringing blood to the lungs, kidneys, and arms and legs. CT combines the use of x-rays with computerized analysis of the images. Beams of x-rays are passed from a rotating device through the area of interest in the patient's body from several different angles to create cross-sectional images, which then are assembled by computer into a three-dimensional picture of the area being studied. Compared to catheter angiography, which involves placing a sizable catheter and injecting contrast material into a large artery or vein, CTA is a much less invasive and more patient-friendly procedure—contrast material is injected into a small peripheral vein by using a small needle or catheter. This type of exam has been used to screen large numbers of individuals for arterial disease. Most patients undergo CT angiography without being admitted to a hospital.

### What are some common uses of the procedure?

CTA is commonly used to:

- Examine the pulmonary arteries in the lungs to rule out pulmonary embolism, a serious but treatable condition.
- Visualize blood flow in the renal arteries (those supplying the kidneys) in patients with high blood pressure and those suspected of having kidney disorders. Narrowing (stenosis) of a renal artery is a cause of high blood pressure (hypertension) in some patients and can be corrected. A special computerized method of viewing the images makes renal CT angiography a very accurate examination. Also done in prospective kidney donors.

- Identify aneurysms in the aorta or in other major blood vessels. Aneurysms are diseased areas of a weakened blood vessel wall that bulges out—like a bulge in a tire. Aneurysms are life-threatening because they can rupture.
- Identify dissection in the aorta or its major branches. Dissection means that the layers of the artery wall peel away from each other—like the layers of an onion. Dissection can cause pain and can be life-threatening.
- Identify a small aneurysm or arteriovenous malformation inside the brain that can be life-threatening.
- Detect atherosclerotic disease that has narrowed the arteries to the legs.
- Detect thrombosis (clots) in veins, for example large veins in the pelvis and legs. Such clots can travel to the lungs and result in pulmonary embolism.

CTA is also used to detect narrowing or obstruction of arteries in the pelvis and in the carotid arteries, which bring blood from the heart to the brain. When a stent has been placed to restore blood flow in a diseased artery, CT angiography will show whether it is serving its purpose. Examining arteries in the brain may help reach a correct diagnosis in patients who complain of headaches, dizziness, ringing in the ears or fainting. Injured patients may benefit from CTA if there is a possibility that one or more arteries have been damaged. In patients with a tumor, it may be helpful for the surgeon to know the details of arteries feeding the growth.

## How should I prepare for the procedure?

Depending on the part of the body to be examined, you may be asked to take only clear liquids by mouth before CTA. You may be asked whether you have asthma or any allergies to foods or drugs, and what medications you are currently taking. If you are pregnant, you should inform the technologist before the procedure. You probably will not have to undress if you are undergoing an exam of the head, neck, arms or legs but you will have to remove any jewelry, hair clips, dentures and the like that could show up on the x-rays and make them hard to interpret.

## What does the equipment look like?

A CT scanner is a specialized x-ray machine that looks like a large square doughnut. It has an opening measuring about two feet in diameter that surrounds a narrow table. Inside the frame of the scanner is a rotating device with an x-ray tube mounted on one side and a banana-shaped detector opposite it. Nearly all CTA studies use an advanced type of unit called a spiral CT machine that looks like any other type of CT unit, but is able to record a large number of pictures in a short time. This means that patients do not have to hold their breath for a prolonged period.



An example of the CT equipment that may be used is shown above.

## How does the procedure work?

Before the actual exam begins, you will have a dose of contrast material injected into a vein to make the blood vessels stand out. An automatic injector machine is used that controls the timing and rate of injection, which may continue during part of the time images are

recorded. During the examination, the rotating device spins around the patient, creating a fan-shaped beam of x-rays, and the detector takes snapshots of the beam after it passes through the patient. As many as one thousand of these pictures may be recorded in one turn of the detector. The real work of CTA comes after the images are acquired, when powerful computer programs process the images and make it possible to display them in different ways, for instance, in cross-sectional slices or as three-dimensional "casts" of the blood vessels.

## How is the procedure performed?

Most of the time for a CTA examination is spent setting everything up. Actually recording the images takes only seconds. After changing into a hospital gown and having an IV set up, you will answer questions about things that might complicate the exam (such as allergies), and then you will lie down on a narrow table. The part of your body to be examined will be placed inside the opening of the CT unit with the aid of criss-crossed positioning lights. A test image is taken to determine the best position, and a small dose of contrast material may be given to see how long it takes to reach the area under study. Then the IV is hooked up to an automatic injector, contrast material is injected, and the scan begins. Afterward, the images will be reviewed and, if necessary, some will be repeated.

## What will I experience during the procedure?

CTA takes about 10 to 25 minutes from the time the actual examination begins. Overall, you can expect to be in or near the examining room for 20 to 60 minutes. You may feel warm all over when contrast material is injected, but you should not feel pain at any time. Any CT study requires that you remain still during the exam. Pillows and foam pads may help make it more comfortable. At the same time, the nurse or technologist may use pads or Velcro straps to keep an area of your body from moving. The examination table will move into and out of the scanner opening, but it is not enclosed, and only a small part of your body will be inside at any one time. You may be asked to hold your breath for 10 to 25 seconds to be sure that the images will not be blurred. During the time that no actual imaging is taking place, you are free to ask questions or talk to the technologist, but friends or relatives will not be allowed in the examining room. Once the needed images have been recorded, you will be free to leave. You can eat immediately, and it is a good idea to drink plenty of fluids in the hours after the exam to help flush contrast material out of the system.

## Who interprets the results and how do I get them?

A radiologist, who is a physician experienced in CTA and other radiology examinations, will analyze the images and send a report to your personal physician, who in turn will discuss the findings with you. Typically the results of CTA are available within 24 hours, although in complicated cases special computer analysis may take somewhat longer.

## What are the benefits vs. risks?

### Benefits

- CTA can be used to examine blood vessels in many key areas of the body, including the brain, kidneys, pelvis, and the lungs. The procedure is able to detect narrowing of blood vessels in time for corrective therapy to be done.
- This method displays the anatomical detail of blood vessels more precisely than magnetic resonance imaging (MRI) or ultrasound. Today, many patients can undergo CTA in place of a conventional catheter angiogram.
- CTA 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.

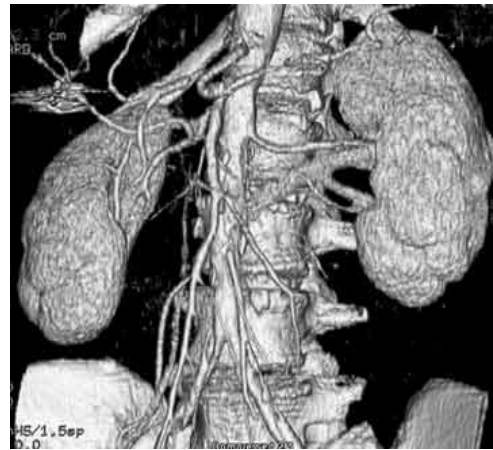
### Risks

- There is a risk of an allergic reaction—which may be serious—whenever contrast material containing iodine is injected. If you have a history of allergy to x-ray dye, your radiologist may advise that you take special medication for 24 hours before CTA to lessen the risk of allergic reaction. Another option is to undergo a different exam that does not call for contrast material injection.
- CTA should be avoided in patients with kidney disease or severe diabetes because x-ray contrast material can further harm kidney function.
- If a large amount of x-ray contrast material leaks out under the skin where the IV is placed, skin damage can result. If you feel any pain in this area during contrast material injection, you should immediately inform the technologist.

- 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 CTA contrast material has cleared from your body. Pregnant women, especially those in the first three months, should not undergo CTA or any exam that exposes them to x-rays.
- Women should always inform their doctor or x-ray technologist if there is any possibility that they are pregnant.

## What are the limitations of CT Angiography?

CTA images of blood vessels anywhere in the body may be fuzzy if the patient moves during the exam or if the heart is not functioning normally. Blocked blood vessels may also make the images hard to interpret. CTA is not yet able to reliably image small, twisted arteries or vessels in organs that move rapidly.



*Abdominal aorta and arteries to the kidneys and intestines.*

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