

## CT Angiography (CTA)

Computed tomography angiography (CTA) uses an injection of contrast material into your blood vessels and CT scanning to help diagnose and evaluate blood vessel disease or related conditions, such as aneurysms or blockages. CTA is typically performed in a radiology department or an outpatient imaging center.

Tell your doctor if there is a possibility you are pregnant and discuss any recent illnesses, medical conditions, medications you are taking, and allergies. You will be instructed not to eat or drink anything several hours beforehand. If you have a known allergy to contrast material, your doctor may prescribe medications to take before the CTA exam to reduce the risk of an allergic reaction. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown. If you are breastfeeding, talk to your doctor about how to proceed.



## What is CT Angiography?

Doctors use angiography to diagnose and treat blood vessel diseases and conditions. Angiography exams produce pictures of major blood vessels throughout the body. Most exams use contrast material (<http://www.radiologyinfo.org>).

Doctors perform angiography using:

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

CT angiography uses a CT scanner to produce detailed images of both blood vessels and tissues in various parts of the body. During the exam, contrast material is injected through a small catheter (<http://www.radiologyinfo.org>) placed in a vein of the arm. A radiologic technologist will capture high-resolution CT images while the contrast material flows through the blood vessels.

## What are some common uses of the procedure?

CT angiography is helpful in examining blood vessels and the organs supplied by them in various body parts, including:

- brain
- neck
- heart
- chest
- abdomen (such as the kidneys and liver)
- pelvis
- legs and feet
- arms and hands

Physicians use CT angiography to diagnose and evaluate many diseases of blood vessels and related conditions such as:

- aneurysms
- blockages
- blood clots
- congenital (birth-related) abnormalities of the cardiovascular system, including the heart
- disorganized blood vessels, such as vascular malformations
- injury
- tumors
- vessel rupture or tears

Also, physicians use CT angiography to check blood vessels before or following surgery to:

- identify abnormalities, such as **aneurysms** (<http://www.radiologyinfo.org>) , in the aorta, both in the chest and abdomen, or in other arteries.
- detect **atherosclerotic** (<http://www.radiologyinfo.org>) (plaque) disease in the carotid artery of the neck, which may limit blood flow to the brain and cause a stroke.
- identify a **arteriovenous malformation** (<http://www.radiologyinfo.org>) inside the brain or elsewhere.
- detect plaque disease that has narrowed the arteries to the legs and help prepare for angioplasty/stent placement or surgery.
- detect disease in the arteries to the kidneys or visualize blood flow to help prepare for a kidney transplant or stent placement.
- guide interventional radiologists and surgeons making repairs to diseased blood vessels, such as implanting **stents** (<http://www.radiologyinfo.org>) or evaluating a stent after implantation.
- detect injury to one or more arteries in the neck, chest, abdomen, pelvis, or limbs following trauma.
- evaluate arteries feeding a tumor prior to surgery or other procedures such as chemoembolization or selective internal radiation therapy.
- identify **dissection** (<http://www.radiologyinfo.org>) or splitting in the aorta in the chest or abdomen or its major branches.
- show the extent and severity of coronary artery disease and its effects and plan for an intervention, such as a **coronary bypass** (<http://www.radiologyinfo.org>) and stenting.
- examine pulmonary arteries in the lungs to detect pulmonary embolism (<https://www.radiologyinfo.org/en/info/pulmonary-embolism>) (blood clots, such as those traveling from leg veins) or pulmonary arteriovenous malformations.
- look at congenital abnormalities in blood vessels, especially arteries in children (e.g., malformations in the heart or other blood vessels due to congenital heart disease).
- evaluate **stenosis** (<http://www.radiologyinfo.org>) and obstructions of vessels.

## 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.

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.*

If you are breastfeeding at the time of the exam, ask your doctor how to proceed. It may help to pump breast milk ahead of time. Keep it on hand for use until all contrast material has cleared from your body (about 24 hours after the test). However, the most recent American College of Radiology (ACR) Manual on Contrast Media reports that studies show the amount of contrast absorbed by the infant during breastfeeding is extremely low. *For further information please consult the ACR Manual on Contrast Media (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) and its references.*

## What does the equipment look like?

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?

There are many similarities between conventional x-ray imaging and CT scanning. During conventional x-ray imaging, a single x-ray beam source sends x-rays through the body. A detector plate captures the x-rays that come out of the body. Based on the amount of x-rays blocked by the body organs, the image will appear in different shades of gray. For example, bones appear white on the x-ray while air is relatively black.

For CT scans, multiple x-ray beam sources and sets of x-ray detectors spin around the body at high speed. The x-ray beam sources send multiple small high-energy x-ray beams through the body. The detectors capture those x-rays that come out of the body. During the examination, you will lie on a table that moves through the CT scanner so that the x-ray beams can examine different areas of the body. Then, a fast computer will take the information gathered from the scanner to produce images of the body. The computer processes a large volume of CT scan data to create two or three-dimensional images of the body.

Radiologists will analyze these images using sophisticated computer programs and high-quality monitors to detect diseases in the body.

Contrast material is injected during the scan to clearly define the blood vessels being examined by making them appear bright white on the images.

## How is the procedure performed?

Prior to, or on the day of the procedure, you may be asked to complete a questionnaire to ensure your safety during this procedure. A nurse or technologist (<http://www.radiologyinfo.org>) will insert an intravenous (<http://www.radiologyinfo.org>) (IV) catheter into a vein, usually in your arm or hand. Rarely, a small amount of blood is withdrawn through the catheter or finger stick to test kidney function.

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.

An automatic injection pump connected to the IV will inject contrast material at a specified rate. In some cases, especially in children and patients with fragile and small veins, the contrast may be hand-injected using a syringe. During scanning, the table is

positioned at the start point of imaging and will then move through the opening of the machine as the actual CT scanning is performed. A single scan takes approximately one to two minutes, but multiple scans may be required.

During CT angiography of the heart, electrocardiogram (ECG) leads (sticky patches) will be placed on your chest to synchronize CT scanning with your heartbeats. If your heart beats too fast, it may be temporarily slowed down with medication to obtain clear images of the heart. If you receive heart rate control medication, you will be closely monitored during and after the procedure.

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>) in the images. This loss of image quality can resemble the blurring seen in a photograph taken of a moving object.

Occasionally, sedation is required for children to keep them still during scanning. Your doctor will help determine if sedation is needed and, if so, will arrange it. Preparation for sedation may include no eating and drinking for several hours before the exam to prevent complications. Also, an extended close observation following the scan may be required until the medication used for sedation wears off.

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.

Following the exam, the technologist will remove the intravenous catheter and place a bandage over the needle puncture site.

The entire CT angiography exam may be over within a few seconds. However, the actual time in the scanner room may be longer, as the technologist will have to appropriately position you on the table, verify placement of the IV line, do preliminary imaging, and set up the scanner and contrast injection pump settings based on the part of the body being imaged.

For children and for adults of reproductive age, the administered radiation dose for CT scans is as low as reasonably achievable using dose reduction measures.

## **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 scan is painless, you may have some discomfort from remaining still for several minutes or from placement of an IV. If you have a hard time staying still, are very nervous, anxious, or in pain, you may find a CT exam stressful. The technologist or nurse, under the direction of a doctor, may offer you some medication to help you tolerate the CT exam.

If the exam uses iodinated contrast material, your doctor will screen you for chronic or acute kidney disease. The doctor may administer contrast material intravenously (by vein), so you will feel a pin prick when the technologist or nurse inserts the needle into your vein. You may feel warm or flushed as the contrast is injected. You also may have a metallic taste in your mouth. This will pass. You may feel a need to urinate. However, these are only side effects of the contrast injection, and they subside 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.

You may need a follow-up exam. If so, your doctor will explain why. Sometimes a follow-up exam further evaluates a potential issue with more views or a special imaging technique. It may also see if there has been any change in an issue over time. Follow-up exams are often the best way to see if treatment is working or if a problem needs attention.

## 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 fast, non-invasive and may have fewer complications compared to conventional angiography.
- CT angiography may provide more precise anatomical details than other angiography exams such as conventional catheter angiography and magnetic resonance imaging (MRI) (<http://www.radiologyinfo.org>) .
- For CT Angiography, there is no need for sedation or general anesthesia.
- CT angiography of the heart helps detect blocked coronary arteries.
- CT angiography may also cost less than catheter angiography.
- 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

Most patients complete CT angiography with no adverse events.

- 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.
- If you have a history of allergy to x-ray contrast material, your doctor may advise you to take special precautionary medication, such as a steroid, for a few hours or the day before CT angiography to lessen the chances of an allergic reaction. Another option is to undergo a different exam that does not require iodinated contrast material.
- In patients who are at risk for kidney failure and who already have borderline kidney function, administering iodinated contrast material could potentially further damage kidney function. Check with your referring doctor and radiologist to obtain more information regarding this risk.
- If a large amount of x-ray contrast material leaks out from the vein being injected and spreads under the skin where the IV is placed, it may damage the skin, blood vessels and nerves. If you feel any pain or tingling sensation in this area during or immediately after the contrast material injection, you should immediately inform the nurse/technologist.
- 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-xray>) page for more information about pregnancy and x-rays.*
- IV contrast manufacturers indicate mothers should not breastfeed their babies for 24-48 hours after contrast material is given. However, the most recent American College of Radiology (ACR) Manual on Contrast Media reports that studies show the amount of contrast absorbed by the infant during breastfeeding is extremely low. *For further information please consult the ACR Manual on Contrast Media (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) and its references.*
- The risk of severe allergic reaction to contrast materials that contain iodine is rare, and hospitals are well-equipped to deal with these reactions.

## A Word About Minimizing Radiation Exposure

Doctors take special care during x-ray exams to use the lowest radiation dose possible while producing the best images for evaluation. National and international radiation protection organizations continually review and update the technique standards radiology professionals use.

Modern x-ray systems minimize stray (scatter) radiation by using controlled x-ray beams and dose control methods. This ensures that the areas of your body not being imaged receive minimal radiation exposure.

Every effort will be made to reduce radiation while performing CT angiography, including tailoring the scan parameters specific to your body type. The scanning area will also be limited to the organ of interest to avoid unnecessary radiation to other body parts.

## **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, they may be over the weight limit—usually 450 pounds—for the moving table.

Some patients with impaired renal function or who previously exhibited a severe allergic reaction to iodinated contrast material may not be candidates for CT angiography.

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