



## Cardiac CT for Calcium Scoring

Cardiac computed tomography (CT) for Calcium Scoring uses special x-ray equipment to produce pictures of the coronary arteries to determine if they are blocked or narrowed by the buildup of plaque – an indicator for atherosclerosis or coronary artery disease (CAD). The information obtained can help evaluate whether you are at increased risk for heart attack.

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 and to avoid caffeine and smoking for four hours prior to the exam. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.

### What is Cardiac CT for Calcium Scoring?

Computed tomography, more commonly known as a CT or CAT scan, is a diagnostic medical test that, like traditional x-rays, produces multiple images or pictures of the inside of the body.

The cross-sectional images generated during a CT scan can be reformatted in multiple planes, and can even generate three-dimensional images. These images can be viewed on a computer monitor, printed on film or transferred to a CD or DVD.

CT images of internal organs, bones, soft tissue and blood vessels provide greater detail than traditional x-rays, particularly of soft tissues and blood vessels.



A cardiac CT scan for coronary calcium is a non-invasive way of obtaining information about the presence, location and extent of calcified plaque in the coronary arteries—the vessels that supply oxygen-containing blood to the heart muscle. Calcified plaque results when there is a build-up of fat and other substances under the inner layer of the artery. This material can calcify which signals the presence of atherosclerosis, a disease of the vessel wall, also called coronary artery disease (CAD). People with this disease have an increased risk for heart attacks. In addition, over time, progression of plaque build up (CAD) can narrow the arteries or even close off blood flow to the heart. The result may be chest pain, sometimes called "angina," or a heart attack.

Because calcium is a marker of CAD, the amount of calcium detected on a cardiac CT scan is a helpful prognostic tool. The findings on cardiac CT are expressed as a calcium score. Another name for this test is coronary artery calcium scoring.

## What are some common uses of the procedure?

The goal of cardiac CT scan for calcium scoring is to determine if CAD is present and to what extent, even if there are no symptoms. It is a screening study that may be recommended by a physician for patients with risk factors for CAD but no clinical symptoms.

The major risk factors for CAD are:

- high blood cholesterol levels
- family history of heart attacks
- diabetes
- high blood pressure
- cigarette smoking
- overweight or obese
- physical inactivity

## How should I prepare?

No special preparation is necessary in advance of a cardiac CT examination. You should continue to take your usual medications, but should avoid caffeine and smoking for four hours prior to the exam.

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. Women will be asked to remove bras containing metal underwire. You may be asked to remove any piercings, if possible.

Women should always inform their physician and the CT technologist if there is any possibility that they may be pregnant. See the Safety page for more information about pregnancy and x-rays.

## 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 in direct visual contact and usually with the ability to hear and talk to you with the use of a speaker and microphone.

## 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 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. The scanner will take a set of images and then the table will move (axial scan). Sometimes the examination table will move during the scan so that the x-ray beam follows a spiral path (spiral or helical scan). 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.

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.

Electron beam computed tomography (EBCT) is an alternative to conventional CT for measuring coronary calcium. In EBCT, an electron beam is sent to a target ring located around the patient. The beam creates x-rays at the target rings, which radiate through the patient to the detector on the opposite end of the scan tube. Because the machine has no moving parts, it can acquire as many as 20 images every second—fast enough so that it avoids any blurring caused by the beating of the heart. While EBCT and CT have been shown to have similar accuracy in determining calcium scores, EBCT is not as commonly available, as it is less versatile than the latest generation of high-speed CT scanners.

## How is the procedure performed?

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

Electrodes (small, sticky discs) will be attached to your chest and to an electrocardiograph (ECG) machine that records the electrical activity of the heart. This makes it possible to record CT scans when the heart is not actively contracting.

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 as the actual CT scanning is performed. Depending on the type of CT scan, the machine may make several passes.

Patients are asked to hold their breath for a period of 10 to 20 seconds while images are recorded.

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.

The entire procedure including the actual CT scanning is usually completed within 10 minutes.

For an EBCT scan, you will lie on a table under an arch-shaped scanner. You may remain clothed and your head will not be enclosed at any time. During the scan, you will be asked to hold your breath at times to help you remain motionless. The procedure takes about 10 to 15 minutes, although the actual scanning time is only a few seconds.

## What will I experience during and after the procedure?

This CT exam is painless, fast and easy.

Though the scanning itself causes no pain, there may be some discomfort from having to remain still for several minutes and with placement of an IV. If you have a hard time staying still, are very nervous or anxious 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.

For exams (excluding head and neck) your head will remain outside the hole in the center of the scanner. The scanner is approximately 24 inches wide, therefore, your entire body will be "inside" the scanner at one time such as with MRI.

When you enter the CT scanner, special light lines may be seen projected onto 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'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 the CT exam, you can return to your normal activities.

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

A radiologist with expertise in supervising and interpreting radiology examinations will analyze the images and send an official report to your primary care physician or physician who referred you for the exam, who will discuss the results with you.

A negative cardiac CT scan for calcium scoring shows no calcification within the coronary arteries. This suggests that CAD is absent or so minimal it cannot be seen by this technique. The chance of having a heart attack over the next two to five years is very low under these circumstances.

A positive test means that CAD is present, regardless of whether or not the patient is experiencing any symptoms. The amount of calcification—expressed as the calcium score—may help to predict the likelihood of a myocardial infarction (heart attack) in the coming years and helps your medical doctor or cardiologist decide whether the patient may need to take preventive medicine or undertake other measures such as diet and exercise to lower the risk for heart attack.

The extent of CAD is graded according to your calcium score:

Follow-up examinations may be necessary. Your doctor will explain the exact reason why another exam is requested. Sometimes a follow-up exam is done because a potential abnormality needs further evaluation with additional views or a special imaging technique. A follow-up examination may also be necessary so that any change in a known abnormality can be monitored over time. Follow-up examinations are sometimes the best way to see if treatment is working or if a finding is stable or changed over time.

## What are the benefits vs. risks?

### Benefits

- Cardiac CT for calcium scoring is a convenient and noninvasive way of evaluating whether you may be at increased risk for a heart attack.
- The exam takes little time, causes no pain, and does not require injection of contrast material.
- An EBCT scan takes less than 20 minutes and you can return to normal activities immediately afterward.
- No radiation remains in a patient's body after a CT examination.
- X-rays used in CT scans 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.

- The effective radiation dose for this procedure varies. See the Safety page for more information about radiation dose.
- 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 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 fetus in the womb.
- A high calcium score may sometimes be followed by other diagnostic tests for heart disease, which may or may not provide results with clinical value and can be associated with side effects.

## What are the limitations of Cardiac CT for Calcium Scoring?

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.

CAD, especially in people below 50 years of age can be present without calcium (non-calcified plaque) and may not be detected by this exam.

Not all health insurance plans cover cardiac CT for calcium scoring.

A high heart rate may interfere with the image quality of the test.

Exactly how your treatment or prevention for heart attacks should be modified according to your calcium score remains uncertain.

EBCT scanners have fewer rows of detectors and lack the spatial resolution of the latest generation CT scanners.

### 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 © 2018 Radiological Society of North America, Inc.