

Cardiac CT Angiography--is it ready for Prime Time?

By

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After being featured on the cover of "Time Magazine" and on the "Oprah Show," the question is no longer whether a Cardiac CT Angiography (Cardiac CTA) is ready for Prime Time. The physicians themselves are asking their cardiology friends where can they get their own Cardiac CTA?

What is Cardiac CT Angiography (Cardiac CTA)?

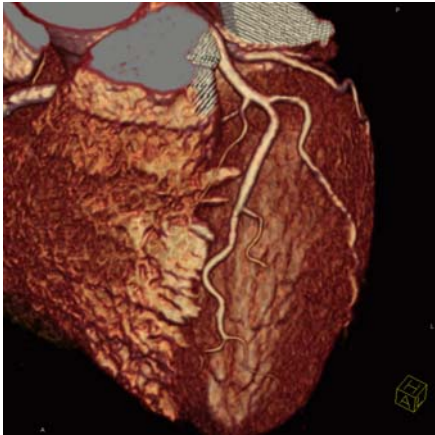
CT (Computer Tomography) has been used for decades in recognizing the structure and function of various internal organs. You are familiar with a donut like machine where the patient is placed and a wide beam X-ray is projected to produce thin slices of the human body called, 'Tomograms'. These tomograms (slices) are stacked one on top of the other to reproduce the structures such as organs, blood vessels, and bones among others.



The heart is the most difficult organ to visualize because of its constant motion. It moves along its length, width, axis, and in time. There is a very narrow window of time during a cardiac cycle (40-80 milliseconds) when the heart is relatively motionless.

The new CT scanners with 16, 32, or 64 detectors (Multi-detector CT = MDCT) can capture multiple heart images during these 40 to 80 milliseconds where the heart is relatively motionless and still. The heart segments are captured on slices as thin as 0.625 mm to enable us to visualize the tiny coronary arteries that measure no more than 1.5 to 4 mm in diameter. These multiple thin slices are stacked one on top of the other, to create an entire image of the heart to help us visualize the coronary arteries, the heart size, the thickness, and the major blood vessels, including the presence of plaque build up.

A highly sophisticated software reformats the images in any direction with the click of a mouse. The same software can allow us to rotate the heart in any direction. We can look at the heart from the front, back, left, right, or any oblique angle to completely evaluate the course of the coronary arteries. It also allows us to slice through the heart at any angle to look at the heart chambers, size, and muscle thickness. A complete description of how Cardiac CT machines function can fill up thousands of pages in an encyclopedia.



A Case in Point

A 45-year-old female patient of mine presented with chest pain and high cholesterol. She underwent a nuclear stress test that we routinely perform to exclude critical coronary artery disease. Her nuclear stress test was abnormal.

Customarily, we would have recommended an invasive procedure--cardiac catheterization to exclude significant coronary artery disease. Instead, I ordered a Cardiac CT Angiography to evaluate her coronary arteries. Her CTA did not reveal any critical coronary artery stenosis. We avoided an un-necessary invasive cardiac catheterization in that patient.

How is Cardiac CTA is performed?

The patient gets an intravenous line set up in the arm for the administration of contrast material. The patient is placed on the CT exam table and connected to EKG, Blood Pressure, and oxygen monitors. To get excellent pictures, the heart rate has to be below 70 beats per minute. If the heart rate is above 70 beats per minute, we administer a beta-blocker to reduce the heart rate to below 70 beats per minute while carefully watching the blood pressure. Once the heart rate is between 55 and 65, the contrast injector is connected to the patient's intravenous line. The table is positioned and preliminary pictures are taken to assess the parameters that are specific to that particular patient.

When these parameters are set, the cardiac CT Angiography test is initiated. The patient is asked to take a breath and hold it on two to three occasions. During the final testing phase, the contrast material (100 mL of iodinated solution) is injected into the patient's vein and it is followed up by 50 mL of saline to flush the intravenous line. The CT scanner will start taking pictures of the chest and heart in rapid sequences. This may last between five to ten heartbeats or anywhere from 5 to 20 seconds. The patient is taken off the exam table and the intravenous line is removed. Then the patient will then be a free agent.

The technician processes the images during various phases of a cardiac cycle. The cardiologist will carefully evaluate the images, map the course of each coronary artery, its branches, look for calcium, blockages, or a soft plaque. The cardiologist will also evaluate the heart size, thickness, and function, including any other abnormalities in and around it. The

radiologist will look at the rest of the chest scan for any non-cardiac findings. Together, they will generate a composite report and make recommendations for the patient.

Where does a Cardiac CTA fit in a cardiologist's practice?

This important question has gripped the attention of cardiologists, managed care carriers, the federal government, and the lawmakers in Washington. The main issues that are being raised are:

- Is Cardiac CTA an additional test increasing the cost of Medicine?
- What existing test does CTA replaced?
- Does this test have an incremental diagnostic value?
- What is the cost of this test?
- How is this test going to be used?
- Who are going to perform this test-- cardiologists or radiologists?
- Who is going to pay for it?

Does Cardiac CT add additional medical cost or diagnostic value?

The answer to this question depends on an individual patient. My patient avoided an unnecessary cardiac catheterization and the cost of the test (\$4000-5000).

Let us look at two studies that compete with Cardiac CTA: the nuclear stress test and the invasive cardiac catheterization.

The nuclear stress testing has been in existence for decades helping cardiologist in evaluating the presence or absence of coronary artery disease, the significance of a coronary artery stenosis, and in predicting the long-term prognosis of patients with known coronary artery disease. Last year alone, eight million nuclear stress tests were performed in the United States alone. Nuclear stress test involves injection of isotope, radiation exposure, takes four to six hours, and costs \$2000-3000. After, all that said and done, if the test is borderline, then we still have to perform invasive cardiac catheterization to exclude significant coronary artery disease. At least, now we have a non-invasive test, 'Cardiac CTA' that can answer that question. Nuclear stress test has a sensitivity of 80-85% and a specificity of 90% where as Cardiac CTA has a specificity of 98%. It is predicted that by year 2012 there will be a 25% decrease in the number of nuclear stress tests ordered yearly.

Cardiac catheterization, on the other hand, is considered a gold standard for the diagnosis of coronary artery disease. However, cardiac catheterization is an invasive procedure that involves spending eight to ten hours in a hospital, contrast administration, radiation, and costs \$4,000-5,000. There is a small risk involved. More than 2.5 million cardiac catheterizations were performed in US in year 2004, and 74% of them were diagnostic catheterizations. It is predicted that by 2012 the number of diagnostic cardiac catheterization is expected to drop by 50%. This change in trend is largely due to the introduction of non-invasive Cardiac CTA.

Benefits of a cardiac CTA

Cardiac CTA, on the other hand, is an outpatient procedure. It can be performed in a doctor's office and it takes less than ten to fifteen minutes. In most cases (>90%) it produces good quality coronary angiograms. It has a specificity of 98%, meaning that it can exclude

significant coronary artery stenosis in 98 out of 100 patients with documented coronary artery disease. It is better than nuclear stress test in excluding critical coronary artery stenosis. Cardiac CTA involves a simple intravenous line, contrast administration, and radiation. The radiation received by a patient during Cardiac CTA is similar to that one receives during a nuclear stress test. On the other hand, the cardiac CTA costs between \$500 to 1,000 dollars.

One of the major centers in Nashville, Tennessee, where eight to ten Cardiac CTAs are performed daily, a 25% decrease in nuclear stress tests and a 48% decrease in diagnostic cardiac catheterizations were noted.

If used appropriately, Cardiac CTA can serve as an important alternative to the present cardiology diagnostic studies, by cutting the time and risk, aiding in the early diagnosis of heart disease, and by reducing the overall medical costs.

Comparison of nuclear stress test, cardiac CTA, and catheterization

Item	Nuclear stress	Cardiac catheterization	Cardiac CTA
Time	4-6 h	6-8 hr	15 min
Place	Office	Yes or outpatient	Office
Type	Non-invasive	Invasive	Non-invasive
Advantage	Function +	Gold standard	Close to gold stand
Specificity	90%	95- 100%	98%
Cost	\$2000-3000	\$4000-5000	\$500-1000
Radiation	8-12 mSv	2-4 mSv	10-14 mSv
Contrast (Iodine)	No	Yes	Yes (IV)
Future prediction	25% drop	40% drop in diagnostic tests	Increase use as people know more
Resolution	10 mm	0.2 mm	0.625 mm

What else can a Multi-detector CT (MDCT) do?

Besides looking at the coronary angiograms, the 64-slice MDCT scanner can help us visualize the entire body, including the vascular structures. Therefore, the same scanner can perform general CTs such as head, neck, chest or abdomen, including the angiograms of the aorta, renal, and leg arteries. Listed below are some sample pictures taken from different parts of the body.

structures and abnormal findings. They serve as an important second opinion in the evaluation of a patient.

However, when it comes to heart and coronary arteries, there are not enough radiologists who are familiar with the heart, coronary arteries, or the cardiac physiology. The cardiologists, who have been performing the cardiac catheterizations for decades, are very well versed with the coronary anatomy, physiology, pathology, and are best qualified to clinically correlate the findings in a given patient.

Hence, it is of utmost importance for both the cardiologists and the radiologist to work in concert when it comes to reading cardiac CTAs. The cardiologist can comment on the cardiac findings while the radiologist reports on the non-cardiac findings on the chest CT. Most major medical centers have created a new combined department, including radiologists and cardiologists to address this same issue.

Where can I get a Cardiac CTA?

I knew, eventually, you would be looking for an answer to this question. At present, there is only a hand full of places in the Houston metroplex area where a 64-slice MDCTs are available. Only a few places perform the cardiac CTA.

In the very near future, a 64-slice MDCT will be available in the Sugar Land area for performing cardiac CTA. Meanwhile, you are encouraged to visit www.sugarlandheartcenter.com to get the first glimpses of Cardiac CTA, including reference from around the world, and look at a gallery of CTA images. If you have any questions or if you are interested in getting a Cardiac CTA, you can contact us at the Sugar Land Heart Center, or you can send e-mail to nikam@alltel.net.



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