

## Case studies: Cardiac applications of CT angiography at William Beaumont Hospitals

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### Introduction

The patients in these case studies were imaged on a 64-slice CT scanner at William Beaumont Hospital's Cardiology Division and analyzed on the Aquarius Workstation from TeraRecon, Inc. The hospital is investigating the role of coronary CTA in the care of patients with acute chest pain in the emergency room, and in analysis of cases with equivocal stress test results. In addition, the Aquarius Workstation was used in the research study comparing CTA to coronary angiography that was published in the August 2nd, 2005 issue of the Journal of the American College of Cardiology.

### Case 1

William Beaumont Hospital was studying the use of coronary artery CTA in the early diagnosis of patients admitted to the emergency room with chest pain. The patient was imaged as a part of the research study.

The patient is a female, aged 22. She complained of three days of constant precordial chest pain unrelated to activity. EKG and cardiac enzymes tests were negative. The patient was felt to have a very low likelihood of cardiac disease, but had juvenile diabetes

from the age of 5. A pregnancy test conducted and showed negative results. She fit the research study criteria and was imaged. CTA showed no evidence of coronary artery calcification.

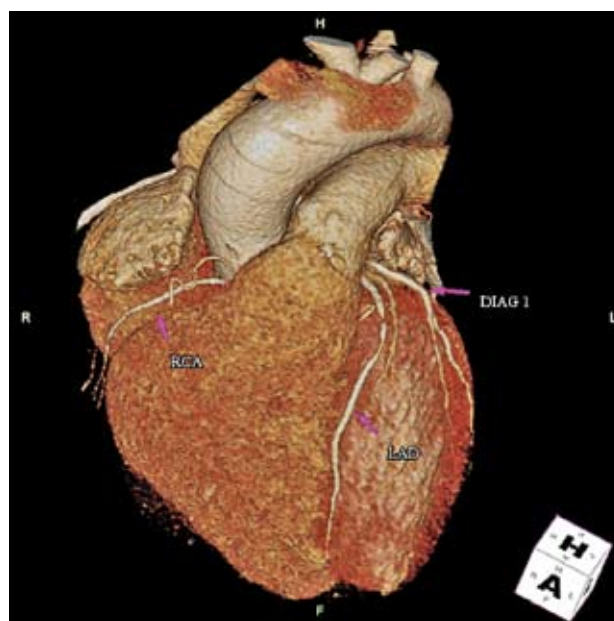
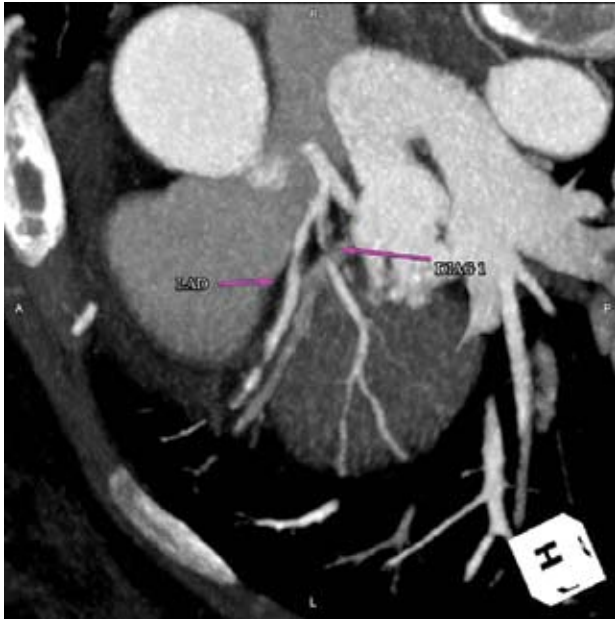


Figure 1. Volume Rendering of Heart



*Figure 2 Thin slab maximum intensity projection of LM and Proximal LAD shows two severe stenoses*



*Figure 3 This figure depicts invasive coronary angiography of the same vessels (left anterior descending and diagonal coronary arteries).*

Figures 1 and 2 depict volume rendering and maximum intensity projection revealing two severe stenoses in the left anterior descending and diagonal coronary arteries.

Fig 3. This figure depicts invasive coronary angiography of the same vessels (left anterior descending and diagonal coronary arteries).

Fig 4. This figure demonstrates a coronary intervention on the vessels and the end result.

### Case 2

The patient is a male, aged 54. He was referred for evaluation due to recurrent chest pain and an equivocal stress test. He has a strong history of early coronary disease and high cholesterol. 4 years ago, he developed chest pain and had a negative stress test. The pain resolved without cardiac therapy. Recently, he had recurrent chest pain and a nuclear stress test was performed. The images were interpreted as normal, but there was 1-2 mm of ST depression in the anterolateral leads.



*Figure 4 This figure demonstrates a coronary intervention on the vessels and the end result.*



Figure 5 Thin slab maximum intensity projection of LM and Proximal LAD shows calcified plaques and soft plaques.

The cardiac CT angiogram revealed combined areas of calcified and non-calcified plaque in the left main and proximal left anterior descending coronary arteries (see Figure 5).

These were confirmed on coronary angiography (see Figure 6), and the patient underwent successful coronary bypass surgery.

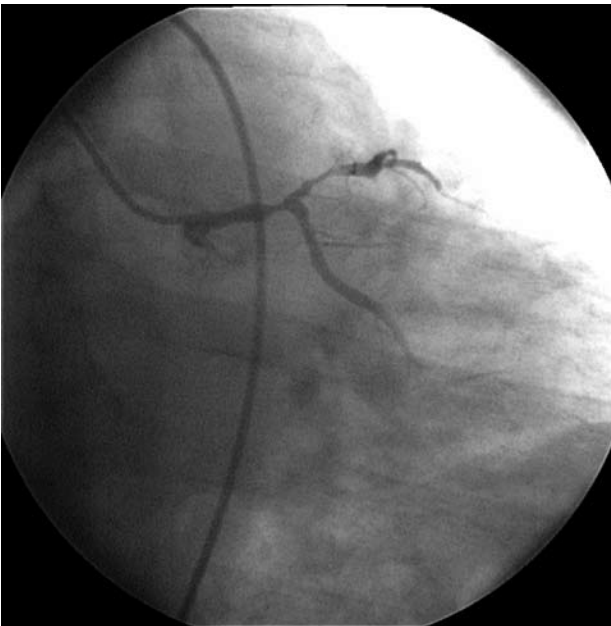


Figure 6 Coronary angiography.

### Case 3

The patient is a female, aged 62. She was admitted for chest pain resulting from physical exertion. An EKG was conducted and showed normal results.

A coronary artery CTA revealed an anomalous right coronary artery originating off the left anterior descending first septal perforator branch.

This is a highly unusual anomaly. The artery was found to pass between the pulmonary artery and aorta, a position, which has been associated with sudden death.

The first image, processed using the 3D module of the Aquarius Workstation, is a volume rendering technique showing the course of the arteries from above (Figure 7).

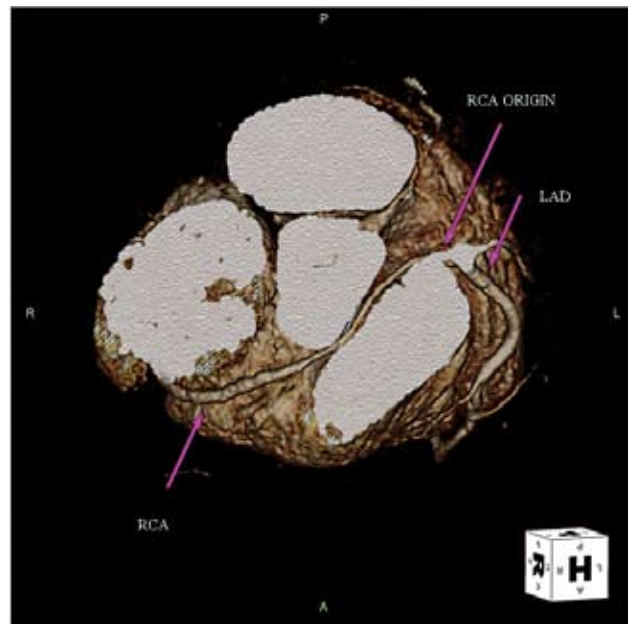


Figure 7 The course of the arteries from above.

The second image is a maximum intensity projection showing the course of the artery between the aorta (posterior) and the pulmonary artery (anterior) (Figure 8).

In the figure, the right coronary is displayed on the left, but is actually located on the patient's right side.



Figure 8 The course of the artery between the aorta and the pulmonary artery.

The third image (Figure 9) displays the arteries from below. In this view, you can appreciate the relatively small size of the vessel compared to its distal course, increasing the risk of ischemia.



Figure 9 The course of the arteries from below.

#### Case 4

The patient is a female, aged 74. She was admitted to evaluate the patency of a left internal mammary graft implanted several years ago. The patient was found to have a patent LIMA graft to the left anterior descending artery, and a congenital anomaly - a persistent left superior vena cava.

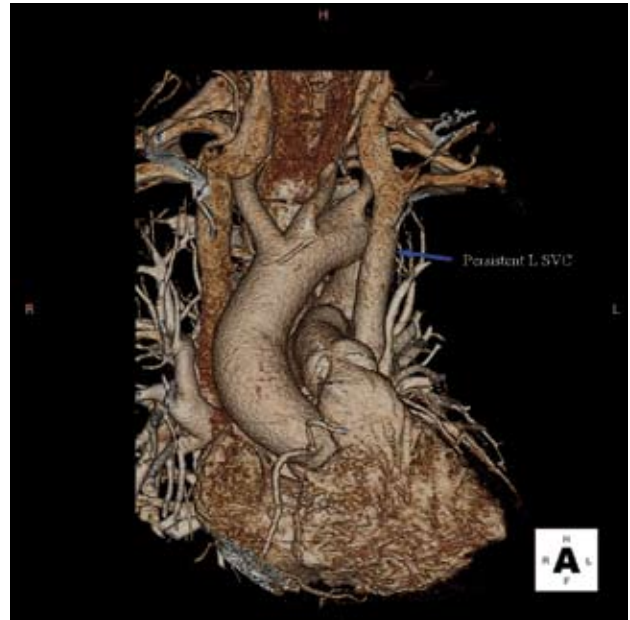


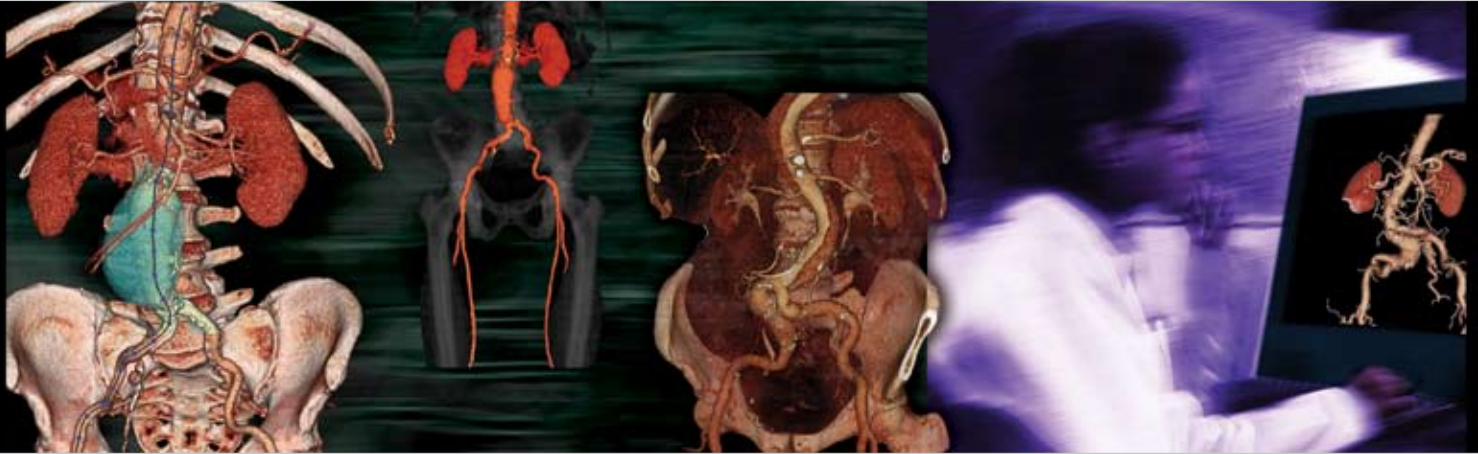
Figure 10 The figure shows an anterior view of a volume rendered image of the heart and great vessels.

Using the labeling tool in Aquarius Workstation, the left vena cava has been labeled with a blue arrow on the patient's left (on the right of the image). Normally, the left superior vena cava is present in fetal life but regresses later, and is of negligible clinical significance. However, in rare instances, it can interfere with adequate cardioplegia during cardiopulmonary bypass. During a bypass, when the cold cardioplegia fluid is introduced through the normal right vena cava, the left superior vena cava unexpectedly dilutes this with warm blood.

## Conclusion

Coronary artery CT angiography has been shown to have a negative predictive accuracy of over 90% when compared to invasive angiography in multiple studies. This lends itself to clinical uses in which determining the absence of disease is critical. In particular, patients with acute chest pain syndromes and negative biomarkers may be quickly analyzed, and cases with equivocal treadmill results can be clarified. Other uses such as analysis of coronary anomalies and the patency of coronary bypass grafts and stents have been greatly enhanced by advances in scanner and three-dimensional workstation technology.

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