CT Clinical Brochure

SURE Cardio Prospective

Low dose, less contrast, robust results

Dear Reader,

Historically, imaging of the heart and coronary arteries with CT began over a decade ago with the first commercial products available on 4-detector-row CT systems. At that time, the success rate for obtaining high-quality examinations was limited by the very long scan times required. A long scan time increases the incidence of beat-to-beat variability, leading to stair-step artifacts and Z-axis discontinuity in the acquired images. The introduction of CT systems with larger numbers of detector rows has led to dramatic reductions in scan times. In 64 and 80-detector-row systems, a scan time of only a few seconds is needed to capture the entire heart with ECG gating, which has allowed coronary CTA to become a routine examination.

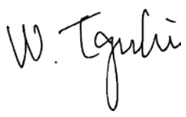
The rapid adoption of CT for evaluating the coronary arteries has been accompanied by an increasing awareness of the relatively high radiation doses associated with retrospective ECG gating. In response to this clinical challenge, manufacturers have developed prospectively gated techniques that expose the heart during only a small portion of the cardiac cycle. Curiously, these solutions were developed for axial step-and-shoot techniques, abandoning the well-known advantages of ECG-gated helical scanning.

Our unique solution was to develop SURECardio Prospective, the only prospective scan mode that retains the shorter scan times and superior Z-axis uniformity of the helical scan technique. The radiation dose is reduced to a fraction of that required for a retrospectively gated study with equivalent image quality.

In the clinical setting, although the radiation dose is a major concern, obtaining a diagnostic examination with a high degree of robustness is even more important. That is why SURECardio Prospective incorporates sophisticated arrhythmia detection algorithms to ensure a diagnostic scan for all patients, no matter the heart rate.

As a part of our suite of Adaptive Diagnostic scan modes, Helical SURECardio Prospective provides the most robust clinical solution for patients undergoing coronary CTA.

Sincerely,



Wataru Taguchi
Senior Vice President
Managing Director CT-MR Division
Canon Medical Systems Corporation

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Reference for Radiation Dose Calculation

Calculation of the effective doses in this brochure is based on the conversion coefficients for patients given in the following publication:

American Association of Physicists in Medicine (AAPM) Report 96. "The Measurement, Reporting, and Management of Radiation Dose in CT." Report of AAPM Task Group 23 of the Diagnostic Imaging Council CT Committee. January 2008.

SURECardio Prospective

Robust Low-Dose Cardiac Imaging

Introduction

Coronary CT angiography has been shown to have good diagnostic accuracy in the detection of significant coronary stenosis as compared to catheter angiography. In particular, the high negative predictive value of this examination has enabled it to become an efficient noninvasive method for determining which patients can be discharged without further imaging. Due to the noninvasive nature and high diagnostic accuracy of coronary CT angiography, this procedure has become widely available in many hospitals, where it is used to evaluate both outpatients and patients who present to the emergency department with chest pain.

Given the rapid acceptance of this technology, a considerable amount of attention has been focused on the radiation dose associated with these examinations. SURECardio Prospective is our unique solution that retains all of the benefits of a helical scan by using a low-dose prospectively triggered exposure window.

Consistent Image Quality

When the detector coverage is not wide enough to cover the heart in a single rotation, techniques such as axial step-and-shoot or helical scanning are used to perform the ECG-gated acquisition. The axial step-and-shoot technique has traditionally provided lower radiation doses than helical scan, but one of the main limitations of the step-and-shoot approach is that the scanner must stop acquiring data while the table is moved between each axial acquisition. Since it is usually impossible to reposition the table fast enough to acquire data within consecutive heartbeats, scanning is performed every second beat. This delay not only results in longer study times and breath-hold times for the patient but also increases the likelihood of encountering beat-to-beat variations resulting in Z-axis misregistration or stair-step artifacts. When this occurs, the affected coronary artery segment is rendered nondiagnostic. Furthermore, differences in contrast opacification between beats create banding artifacts which can hamper the diagnostic evaluation of the coronary arteries.

SURECardio Prospective is different. Employing a helical scan technique, the exposure is turned on only during the diastolic phase of the cardiac cycle. In combination with a fast helical pitch, the ECG-gated acquisition can be performed in less time than a retrospective helical scan, and with a significantly lower dose. Helical scan provides rapid examinations with data acquired every heartbeat resulting in shorter scan times compared to step and shoot techniques. This results in a reduction of the contrast volume required and in addition, misregistration artifacts are substantially reduced.

Heart Rate Adaptive

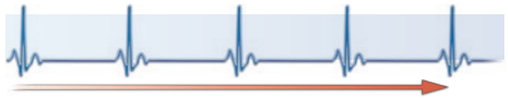
In patients with a slow and steady heart rate, coronary CTA is performed at a very low exposure dose using the prospective helical scan technique during a breath-hold of approximately 4-5 seconds. In patients with a higher heart rate, a wider exposure window encompassing both the systolic and diastolic phases is automatically acquired using prospective helical scan mode, providing a diagnostic scan at a low exposure dose.

Examining patients with unexpected arrhythmias during scanning is a challenge in prospectively triggered scanning because it may not be possible to obtain the correct phase for reconstruction.

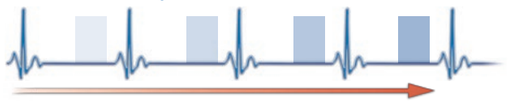
SURECardio Prospective incorporates our proprietary arrhythmia detection algorithm which recognizes irregular cardiac rhythms and controls scan exposure in real time to ensure a diagnostic study. This reduces both the amount of IV contrast and the radiation dose because the need to perform repeat examinations is minimized.

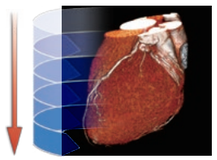
This highly adaptive scan mode ensures a diagnostic examination, regardless of the patient's heart rate. No guesswork is needed.

ECG-Gated Helical Scanning

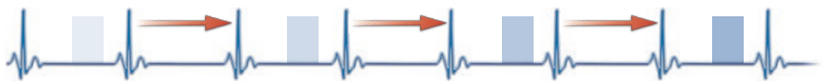


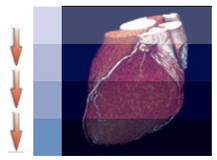
SURECardio Prospective





Step & Shoot Approach



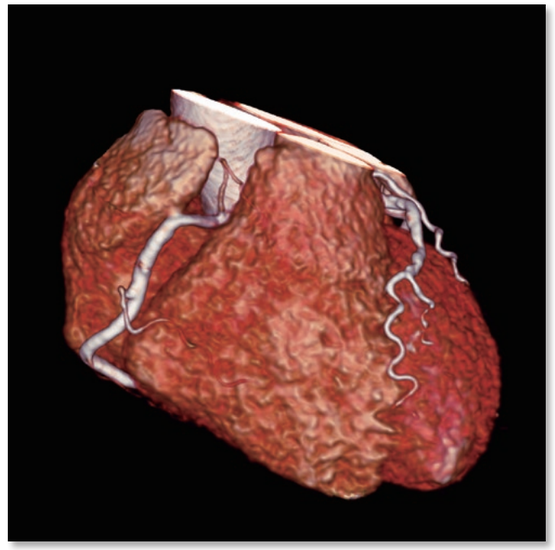


Diffuse Disease

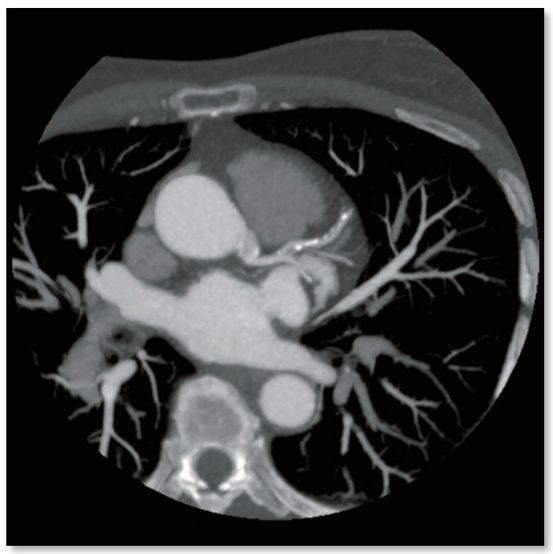
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.237	80	SUREExposure 3D	0.35	115	AIDR* 3D Standard	4	58.8	0.8	0.014

Patient History

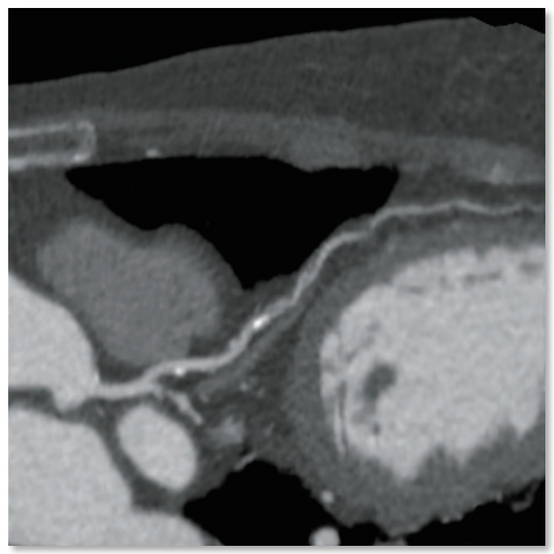
This 51-year-old woman with a BMI of 23 presented with intermittent atypical chest pain. A low-dose CT scan was requested to rule out coronary artery disease.



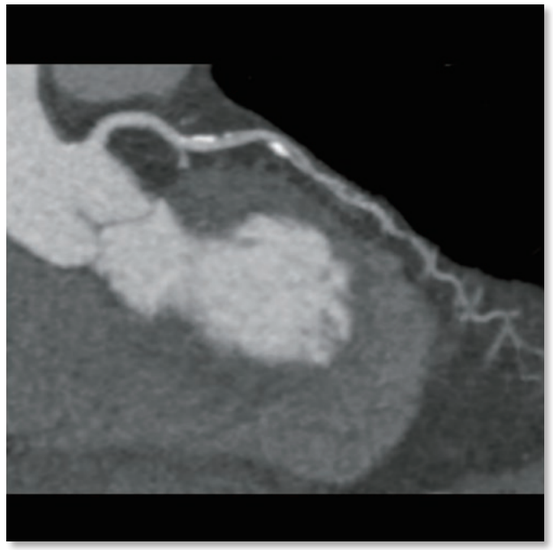
3D VR of the heart



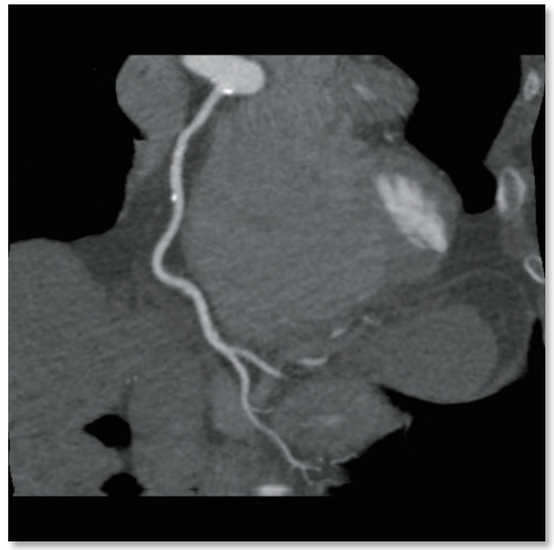
Left coronary MIP



LAD curved MPR



LAD curved MPR



RCA curved MPR

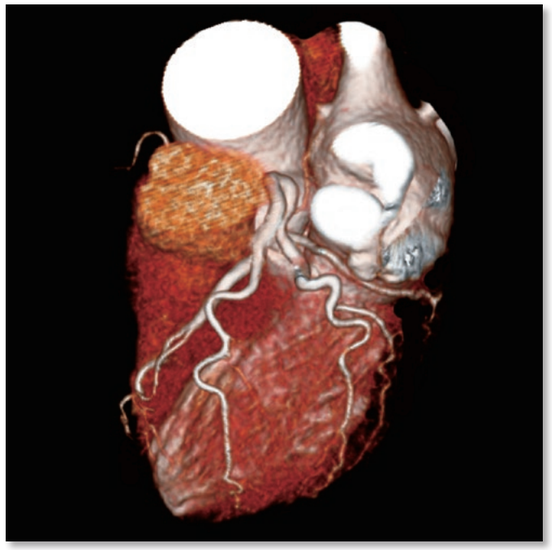
Findings

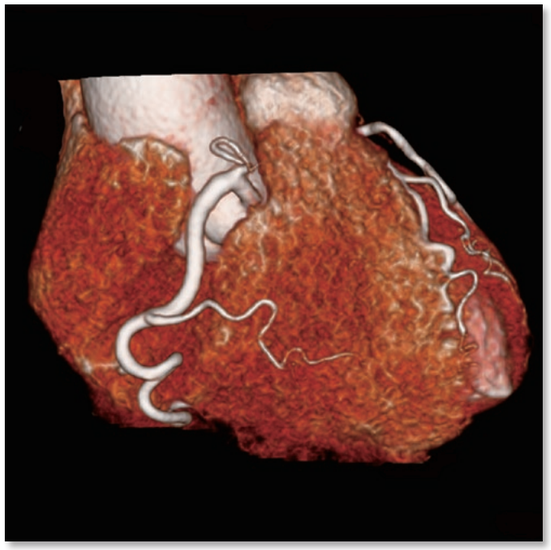
Diffuse disease of the LAD with calcified and noncalcified plaques is demonstrated in the curved MPR images. The RCA shows small calcified plaques that are not considered to be hemodynamically significant.

* Adaptive Iterative Dose Reduction

Tortuous Vessels

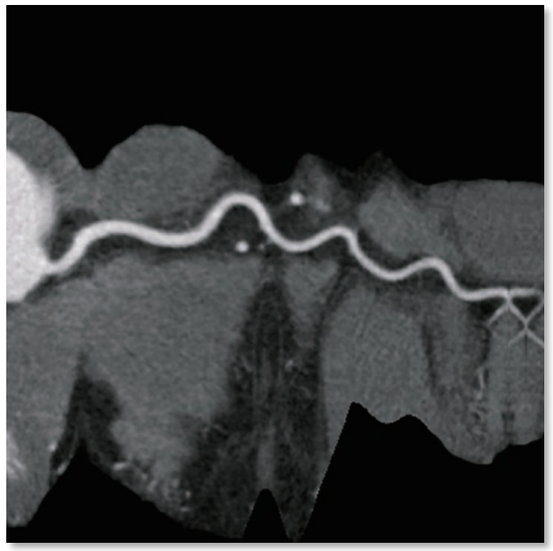
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.256	100	SUREExposure 3D	0.35	117	AIDR 3D Standard	5.3	80.2	1.12	0.014





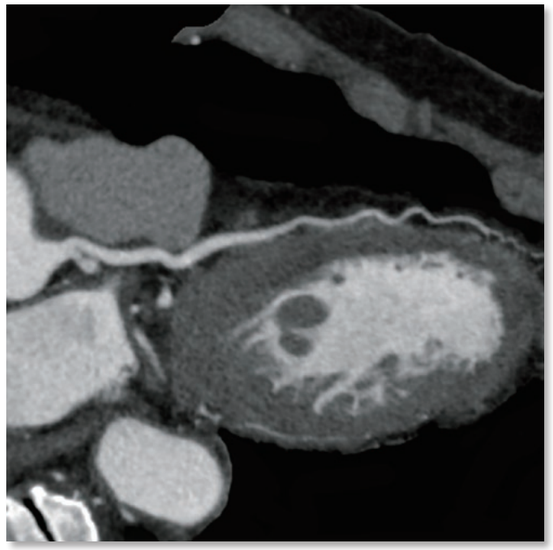
Patient History

This 78-year-old woman with a BMI of 24 presented with atypical chest pain and a family history of coronary artery disease.

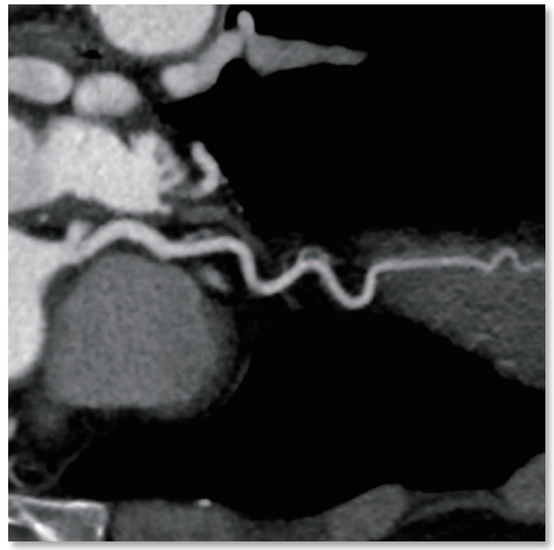


Curved MPR of the RCA

Curved MPR of the LCx



Curved MPR of the LAD



Curved MPR of the first diagonal branch

Findings

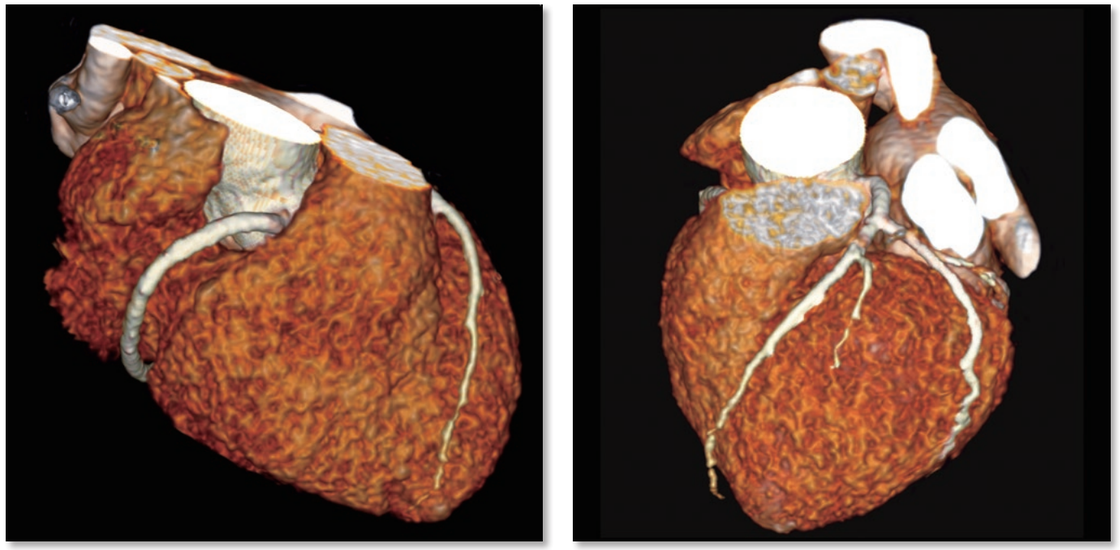
The coronary vessels are tortuous, but no coronary artery disease is demonstrated in this 1.12 mSv scan.

LAD Stenosis

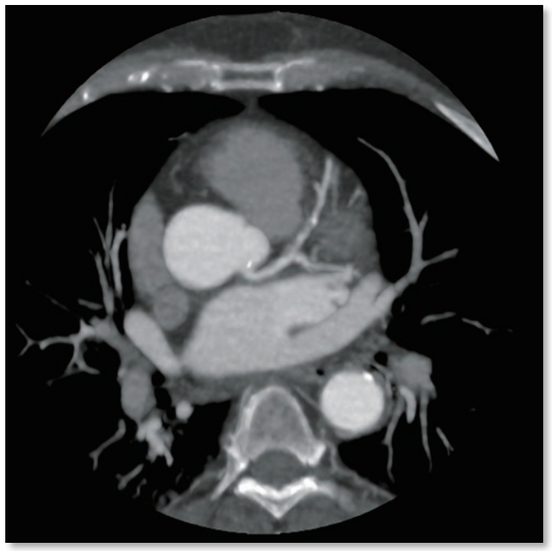
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.195	120	SUREExposure 3D	0.35	111	AIDR 3D Standard	8.6	119.8	1.7	0.014

Patient History

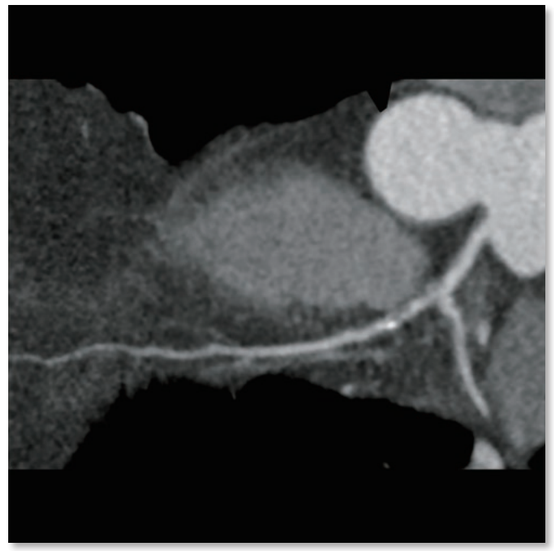
This patient presented with angina and the following risk factors: smoker, type 2 diabetes, and strong family history. A CT angiogram was requested to rule out coronary artery disease.



3D VR of the heart

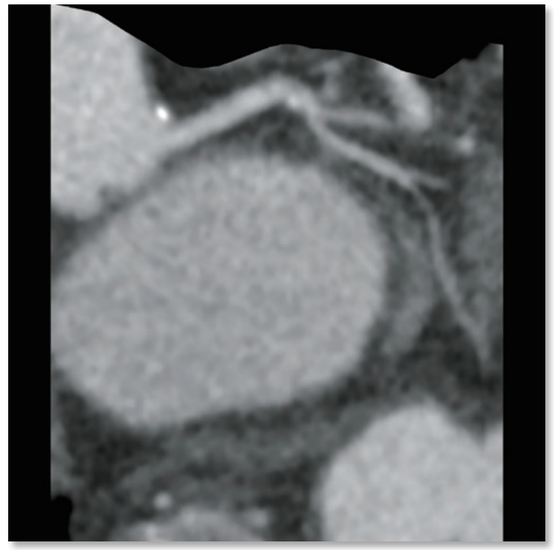


MIP of the LCA



Curved MPR of the LAD

Curved MPR of the RCA



Curved MPR of the LCx

Findings

A hemodynamically significant stenosis of the proximal LAD is demonstrated in the curved MPR images. An incidental calcific plaque adjacent to the ostium of the LCx is seen in the curved MPR image.

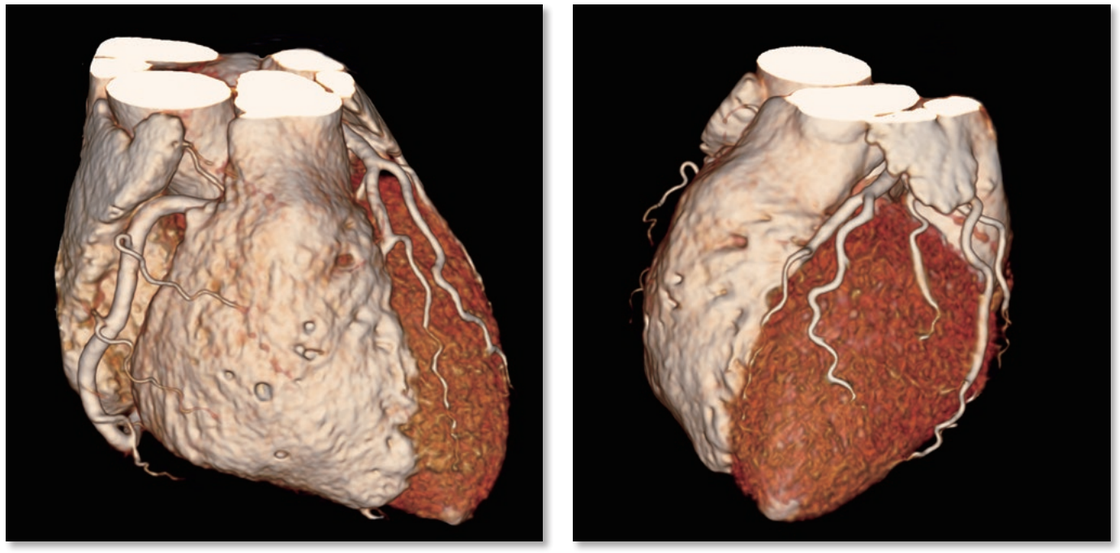
The patient is scheduled to undergo invasive angiography with possible stenting.

Low-Dose Coronary CTA

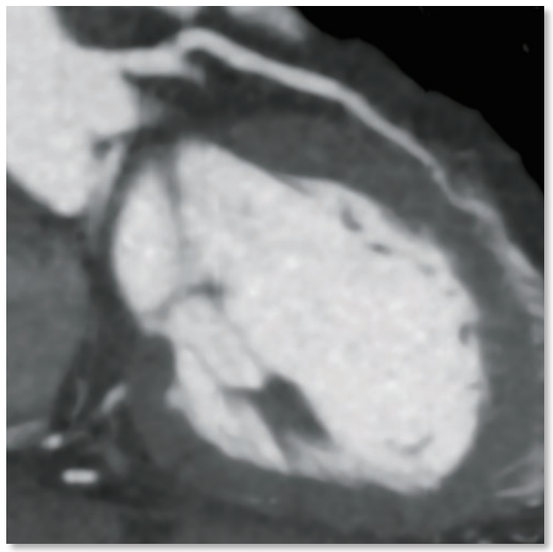
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.213	100	SUREExposure 3D	0.35	135	AIDR 3D Standard	6.9	113.2	1.6	0.014

Patient History

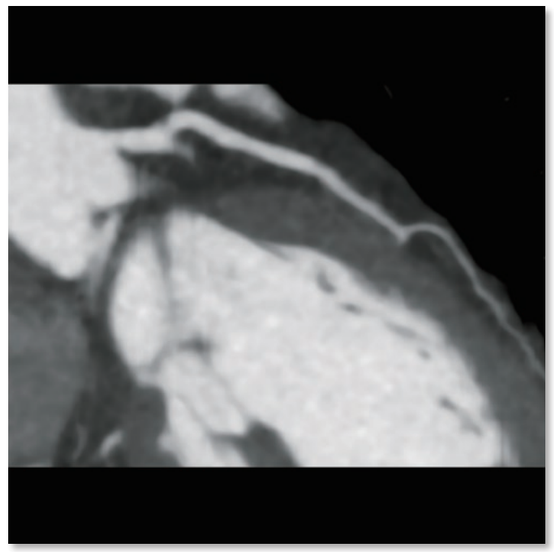
This 44-year-old man with a BMI of 27 presented to the ER with atypical chest pain. He had no known risk factors and was referred for a low-dose CT angiogram to rule out coronary artery disease.



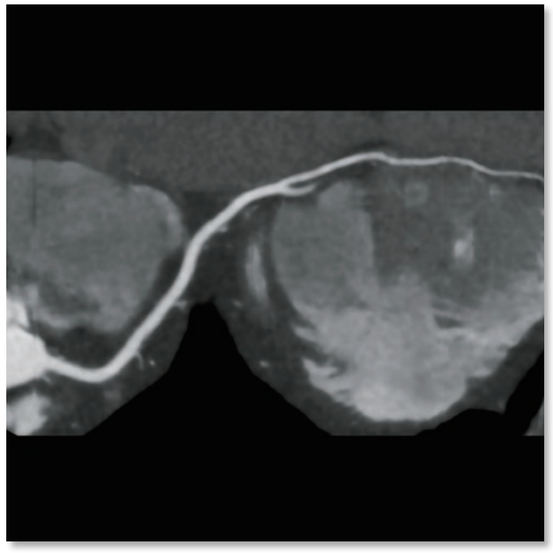
3D VR of the heart



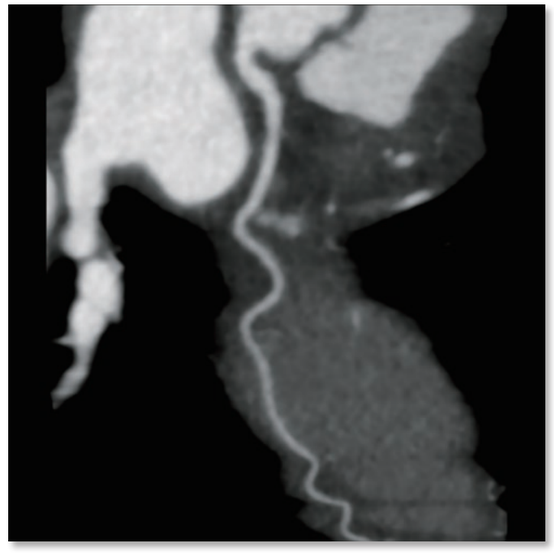
LAD curved MPR



LAD + D2 curved MPR



RCA curved MPR



OM1 curved MPR

Findings

Only 50 cc of contrast agent was used during this low-dose cardiac scan. Mild myocardial bridging was seen in the mid portion of the LAD. No abnormalities were demonstrated and the patient was sent home without the need for further tests.

"With Helical Prospective scanning you get the best of both worlds, low radiation dose and no stair step artifacts. This is simply not possible with step and shoot techniques. With built in automatic arrhythmia detection software, robust results are ensured with SURECardio Prospective."

Dr. Steven D. Wolff
Director,
Advanced Cardiovascular Imaging, New York, USA

"With this system, and Real Time Beat Control, you can reassure referring physicians and technologists that an irregular rhythm is not a contraindication to Cardiac CT."

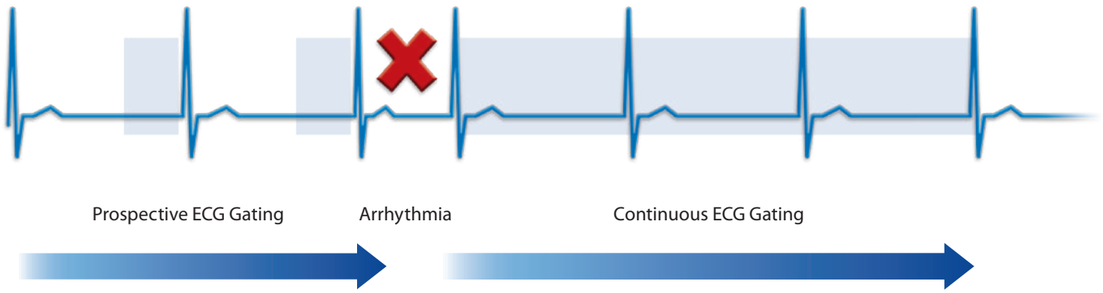
Dr. Robert Peters
Director of Cardiac CT & Body Imaging
Carnegie Hill Radiology, New York, USA

Arrhythmia

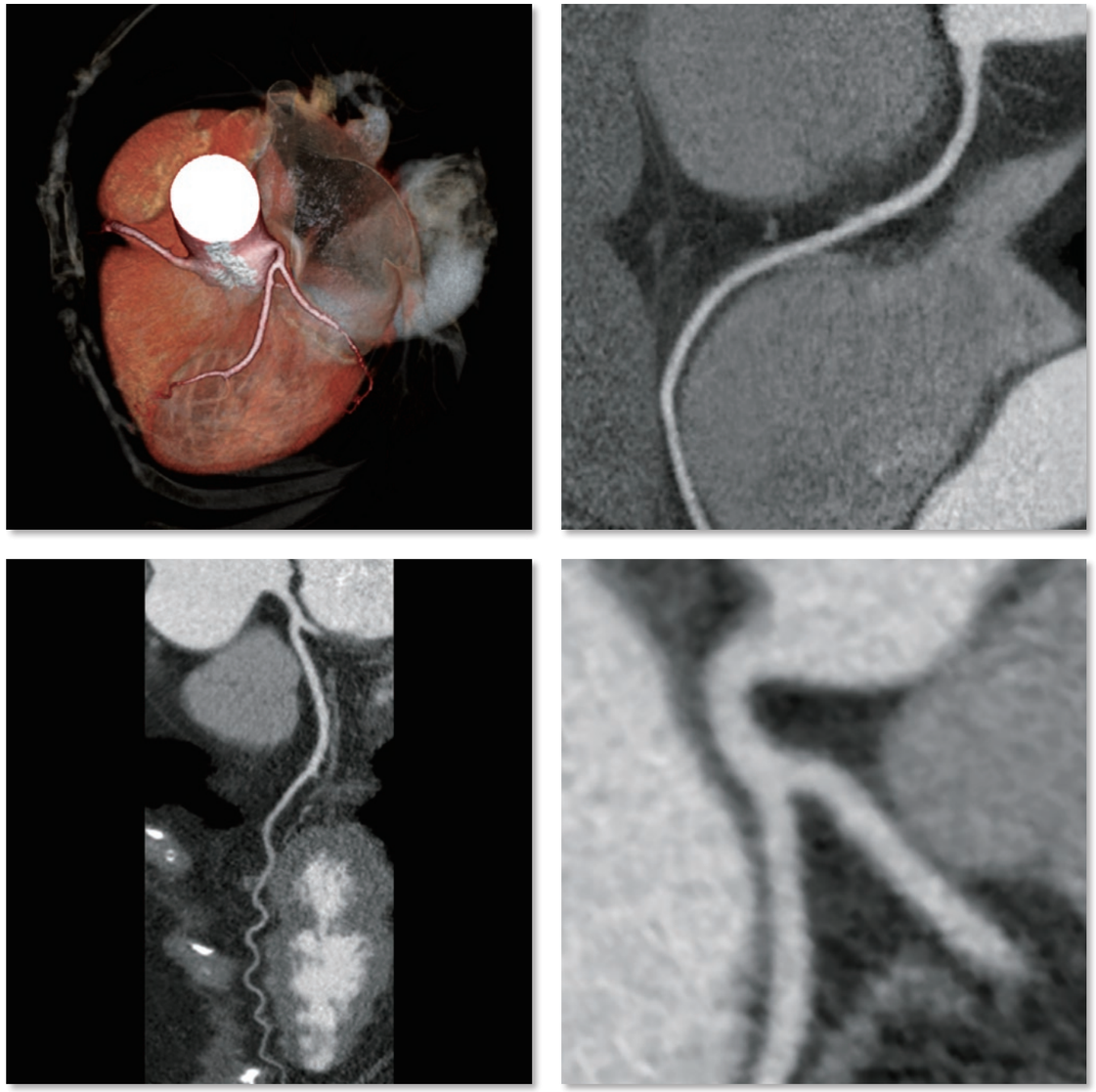
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.256	120	SUREExposure 3D	0.35	120	AIDR 3D Standard	21.4	373	5.0	0.014

Patient History

This 64-year-old man presented with atypical chest pain.



Robust CT angiography with prospective ECG gating. When an arrhythmia is detected, the scan automatically changes to a continuous acquisition to ensure a diagnostic image every time.



Findings

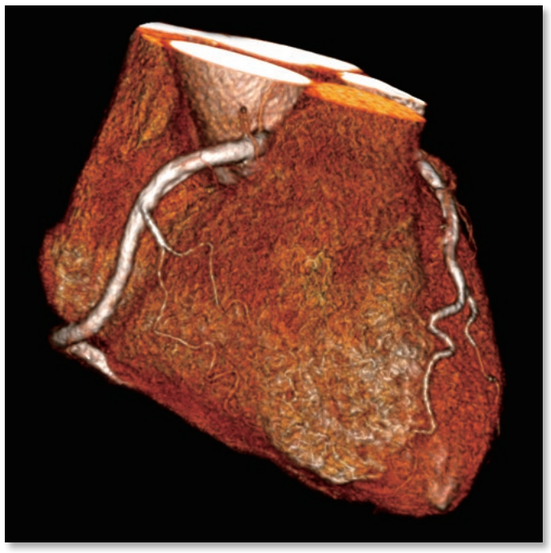
The coronary arteries are normal. The use of automatic arrhythmia detection algorithms ensures that the scan is diagnostic even if the patient experiences an arrhythmia during acquisition.

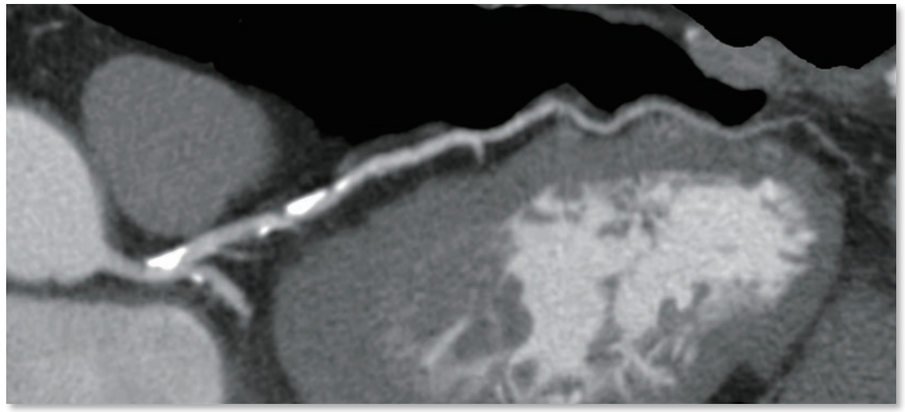
Three-Vessel Disease

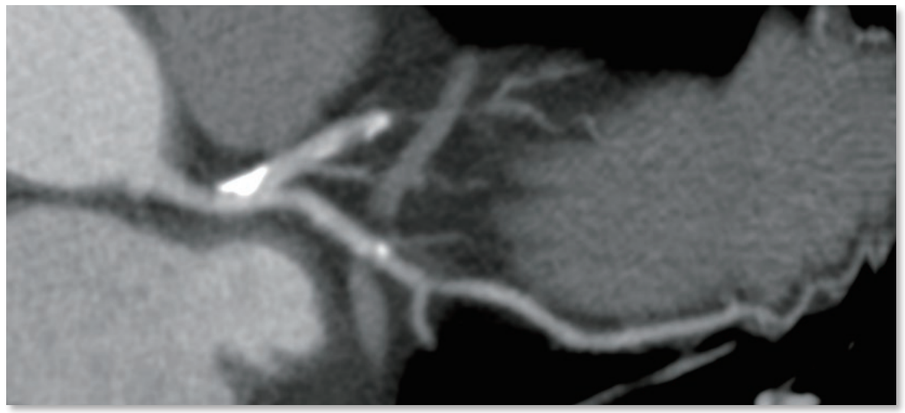
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.256	135	SUREExposure 3D	0.35	111	AIDR 3D Standard	10.4	151	2.1	0.014

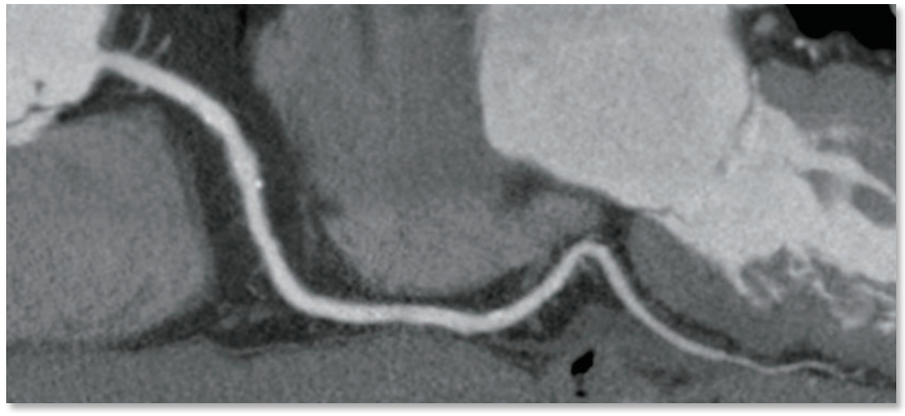
Patient History

This 62-year-old man with a BMI of 20.7 presented with atypical chest pain and an abnormal ECG.







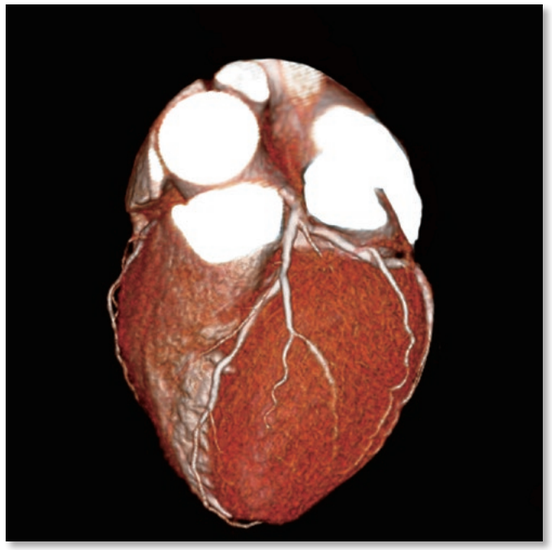


Findings

A calcified lesion is seen in the proximal LAD. A large calcification is also seen in the left main coronary artery. Another lesion is seen in the LCx, distal to the first OM branch. The scan time was 3.5 seconds.

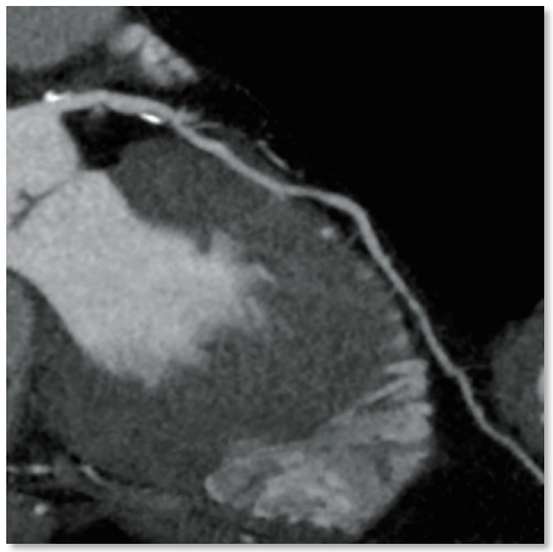
LAD Plaque

Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.256	100	SUREExposure 3D	0.35	120	AIDR 3D Standard	17.8	263.1	3.68	0.014

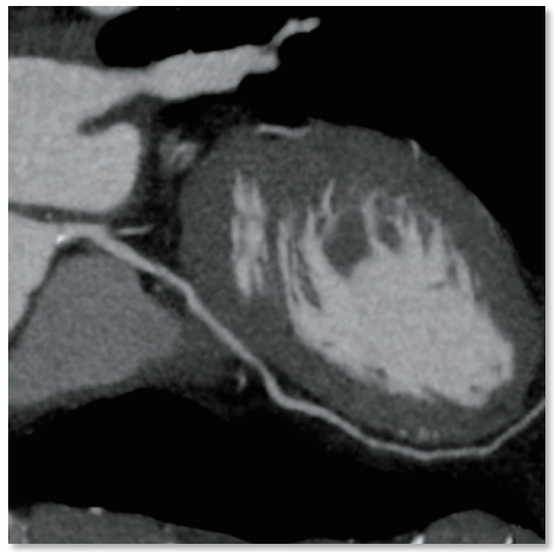


Patient History

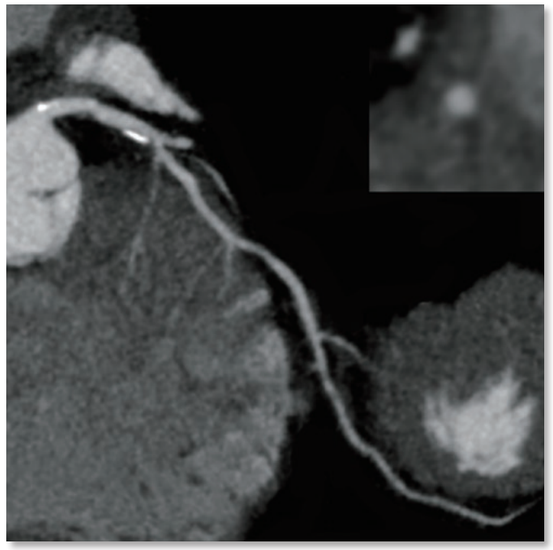
This 57-year-old woman weighing 95 kg presented with atypical chest pain.



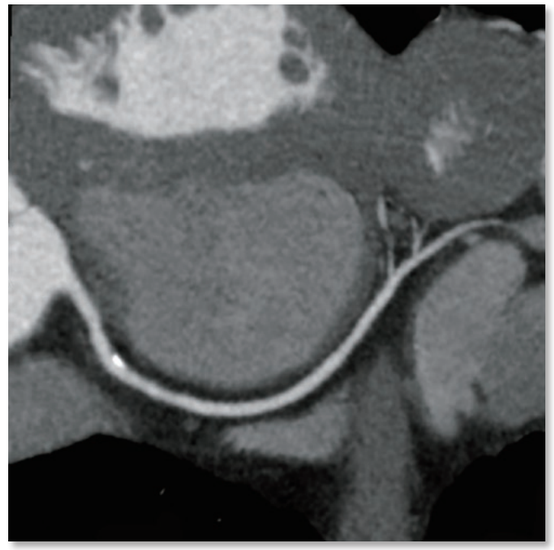
Curved MPR of the LAD



Curved MPR of the LAD



Myocardial bridge in the LAD



Curved MPR of the RCA

Findings

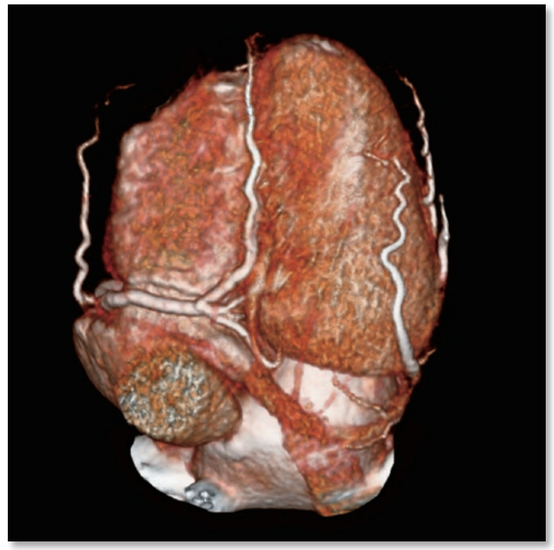
A myocardial bridge is seen in the proximal portion of the LAD. Proximal to the bridge, a small calcified plaque is demonstrated. A small calcified plaque is also seen in the proximal RCA. Neither plaque was considered to be hemodynamically significant.

Diffuse Plaque

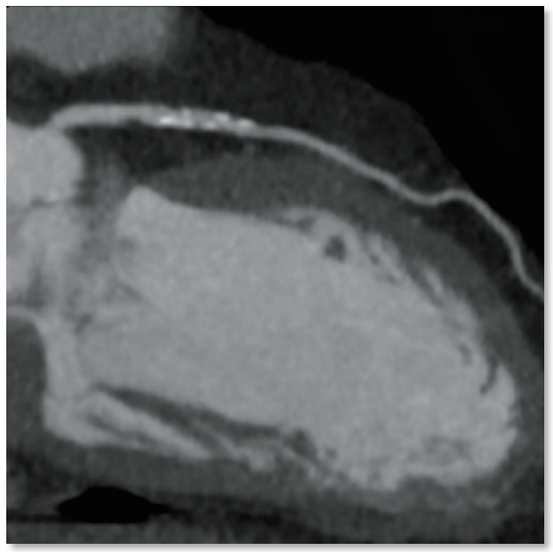
Scan Mode	Collimation	Pitch	kVp	mAs	Rotation Time (s)	Scan Range (mm)	Dose Reduction	CTDIvol (mGy)	DLP (mGy·cm)	Effective Dose (mSv)	k
Ultra Helical	0.5 mm × 80	0.256	100	SUREExposure 3D	0.35	96	AIDR 3D Standard	5.9	75.8	1.06	0.014

Patient History

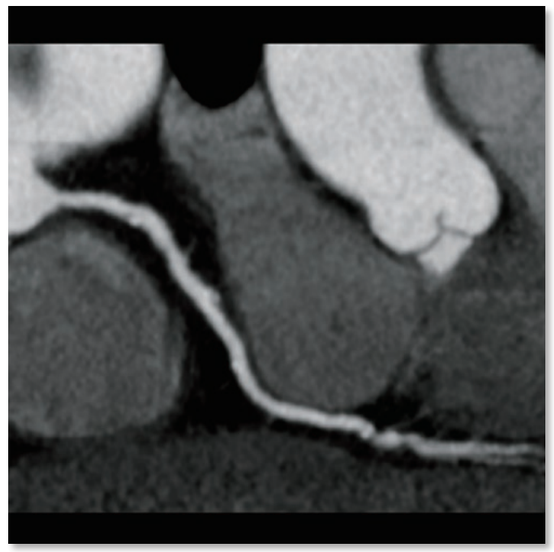
This 66-year-old woman with a BMI of 24 presented with atypical chest pain.



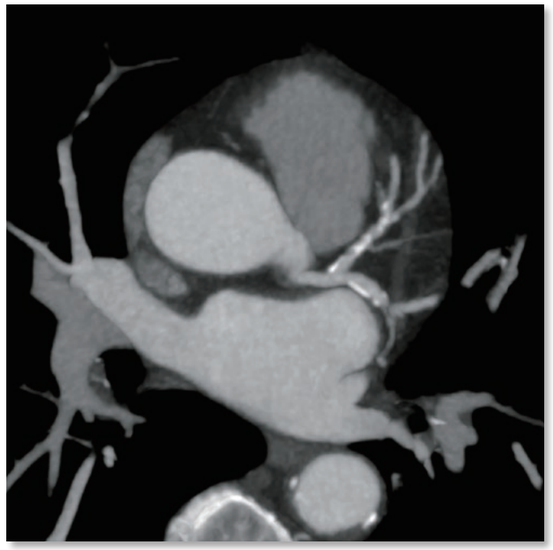
3D VR of the heart



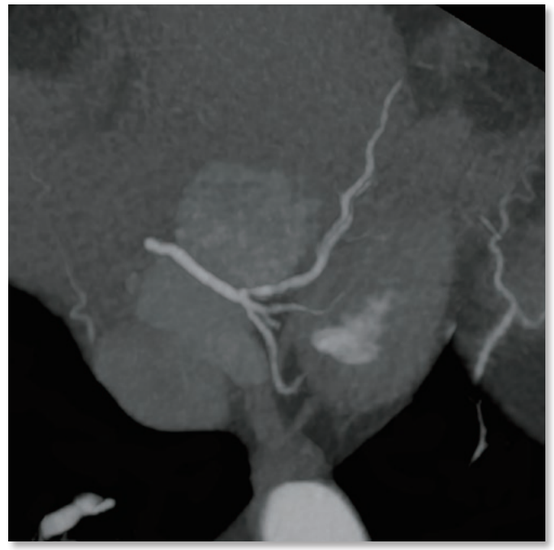
LAD curved MPR



RCA curved MPR



Left coronary MIP



PDA MIP

Findings

Noncalcified plaque is demonstrated in the RCA and LAD. The RCA is dominant, with a large PDA extending to the apex of the heart.

Disclaimer: Any reference to X-ray exposure is intended as a reference guideline only. The guidelines in this document do not substitute for the judgment of a healthcare provider. Each scan requires medical judgment by the healthcare provider about exposing the patient to ionizing radiation. In clinical practice, the use of the AIDR 3D feature may reduce CT patient dose depending on the clinical task, patient size, anatomical location and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.

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