Revolution EVO: Low Dose CCTA with Prospective Gating in the evaluation of plaque burden

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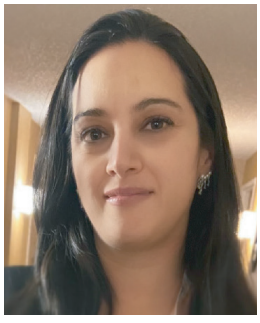
"Performing high resolution prospective ECG triggered CCTA with low radiation dose can be a challenging task. With our recently aquired 128 Slice Revolution Evo CT Scanner, we are able to achieve a low effective radiation dose as 1.9mSv in an overweighted patient (BMI 26) by maintaining excellent diagnostic image quality.".



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Introduction

Patient History

A 71-year-old male was referred to the Imaging Department for Coronary Computed Tomography Angiography (CCTA) for assessing coronary stenosis and plaque burden, after he had done an exercise stress test (treadmill) that suggested myocardial ischemia. He had no symptoms and didn't take any continuous medication, denying hypertension, diabetes, dyslipidemia, smoking or previous catheterization. The patient presented overweight (BMI 26) and had family history for coronary artery disease (CAD). According to our institutional protocol, the patient initially underwent an ECG showing sinus rhythm and a heart rate of 74 bpm. Following the administration of 100mg oral metoprolol and IV hydration he was taken to the CT room. Once the patient was inside the scanner, the IV line was tested and sublingual Isordil 2,5mg administered.

CT Acquisition Protocol

IAxial Slices with prospective cardiac trigger were acquired on our 128-slice CT scanner (Revolution Evo, GE Healthcare, Waukesha, USA) to assess the coronary calcium score. Subsequently, after intravenous injection of 80ml nonionic iodinated contrast (370 mg/ml) at a flow rate of 5ml/s, prospective ECG triggered slices were acquired with dose modulation as follow:
The scan was triggered using an automatic bolus-tracking technique with a region of interest placed in the ascending thoracic aorta, at a threshold of 100 Hounsfield units (HU). Prospective electrocardiogram gating (SnapShot Pulse, GE Healthcare) was used at 75% of the R-R interval. Slice/collimation of 0.625 mm, gantry rotation time of 350 ms, tube current 400 mA at 100 kV and iterative reconstruction: ASIR 50% (Table 1.)
This acquisition protocol resulted in radiation dose of 176.05 mGy.cm (DLP). Images were post processed with **CardIQ** on an Advanced Workstation 4.7 (AW VolumeShare 7), a multi-modality medical image analysis platform.

Acquisition Protocol	Revolution EVO
Tube voltage [kV]	100
Tube current [mAs/rot]	400
Acquisition mode	Prospective
Padding	70-84%
Scan length [mm]	139.3
Scan direction	Cranio caudal
Rotation Time	0.35
Slice collimation [mm]	0.625
Recon Increment	0.6
Slice width [mm]	0.625
Heart rate [bpm]	48-53
Recon kernel	Stand 50% with ASIR V
Contrast [mg/mL]	370
Contrast volume [ml]	70
Flow rate [mL/s]	5.0
Start delay	SmartPrep 100 HU
DLP [mGy*cm]	138.25
CTDIvol [mGy]	9.87
Effective Dose [mSv]	**1.9mSv**

Table 1. Acquisition protocol prospectively gated ECG CCTA

CT Findings

The coronary circulation was right-dominant. Left Main Coronary Artery without significant reduction. Left Anterior Descending artery bypasses the cardiac apex, with calcified and noncalcified plaques throughout the course. The LAD proximal segment has a predominant noncalcified plaque, which determines significant stenoses. Circumflex artery (Cx) with calcified plaques in the proximal and distal segments, with mild luminal reduction. Right coronary artery (RCA) with partially calcified plaques along the entire path, which determine moderate luminal reduction in the mid segment.

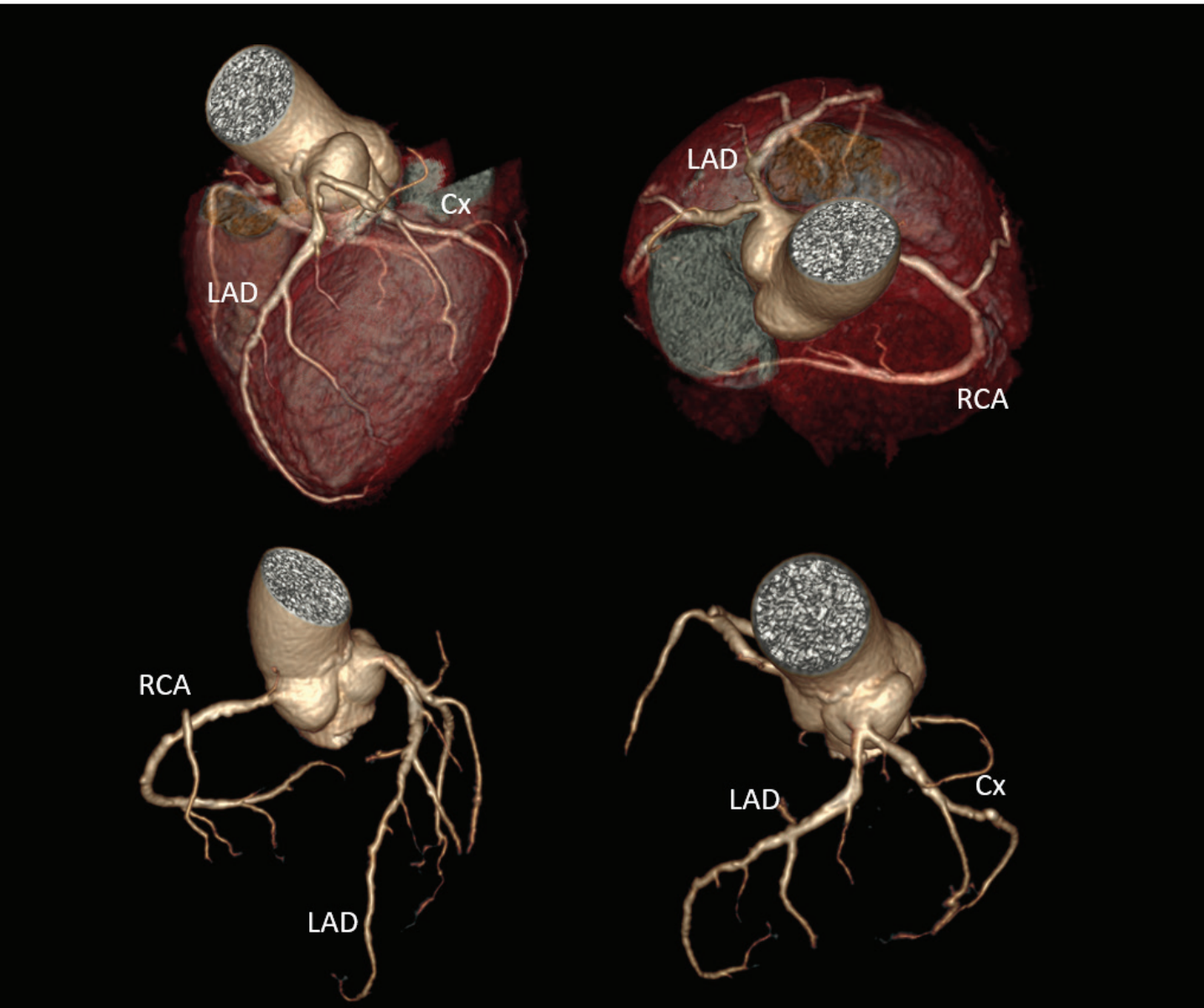


Figure 1. 3D Volume Rendering reconstructions showing a 3D overview of the coronary artery tree and their position relative to the underlying cardiac structures.

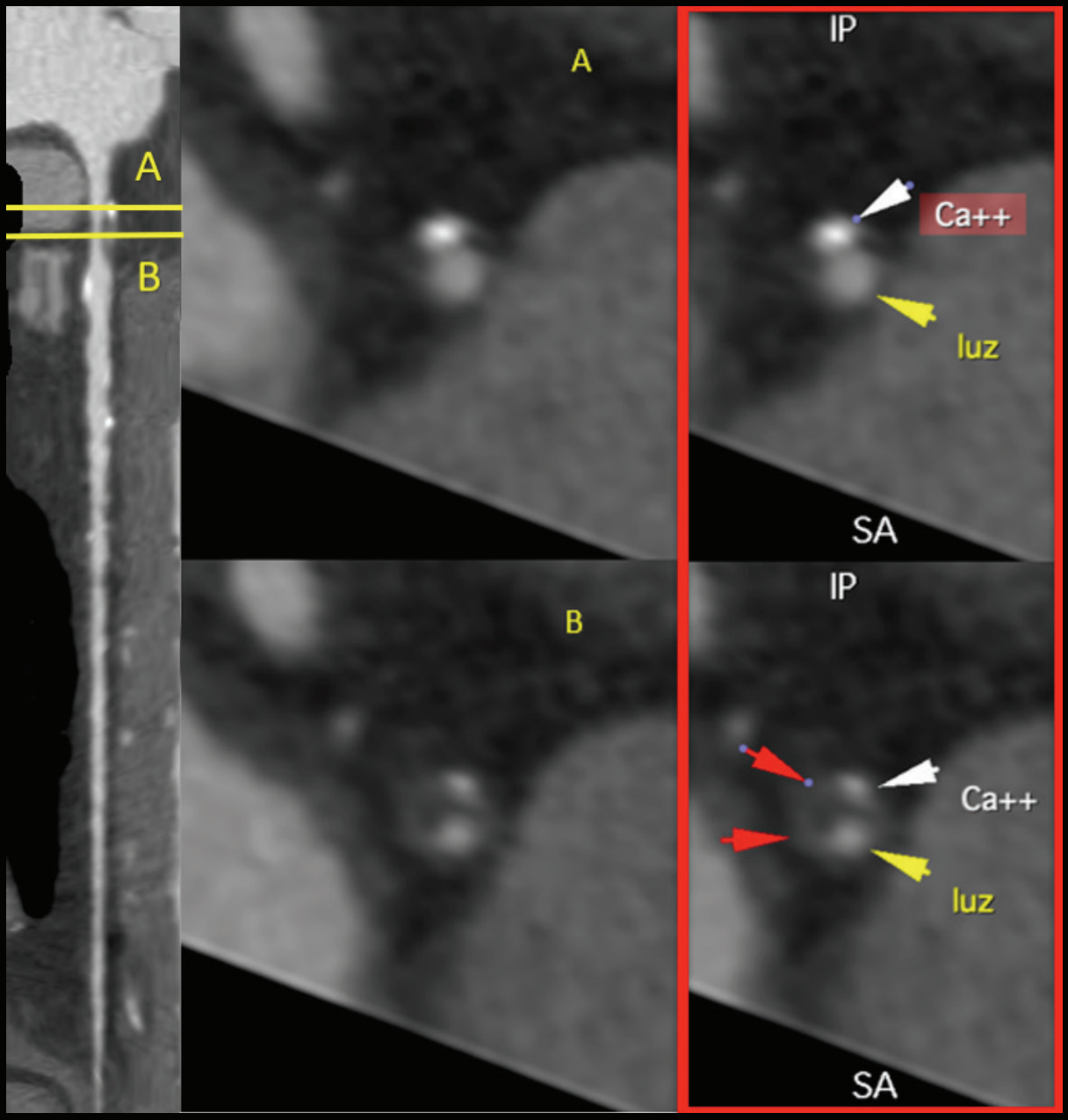


Figure 2. Excellent plaque characterization even with very low radiation exposures (<2 mSv). Severe proximal LAD stenosis showed on straightened Curved Planar Reformation (CPR) – on the left, and the plaque in short-axis view on the right (A and B): mixed plaque in proximal LAD, predominantly non-calcified plaque with positive remodeling and spotty calcification (characteristics related to vulnerable plaque). Red arrows: non-calcified component of the plaque; white arrow: calcium; yellow arrow: lumen.

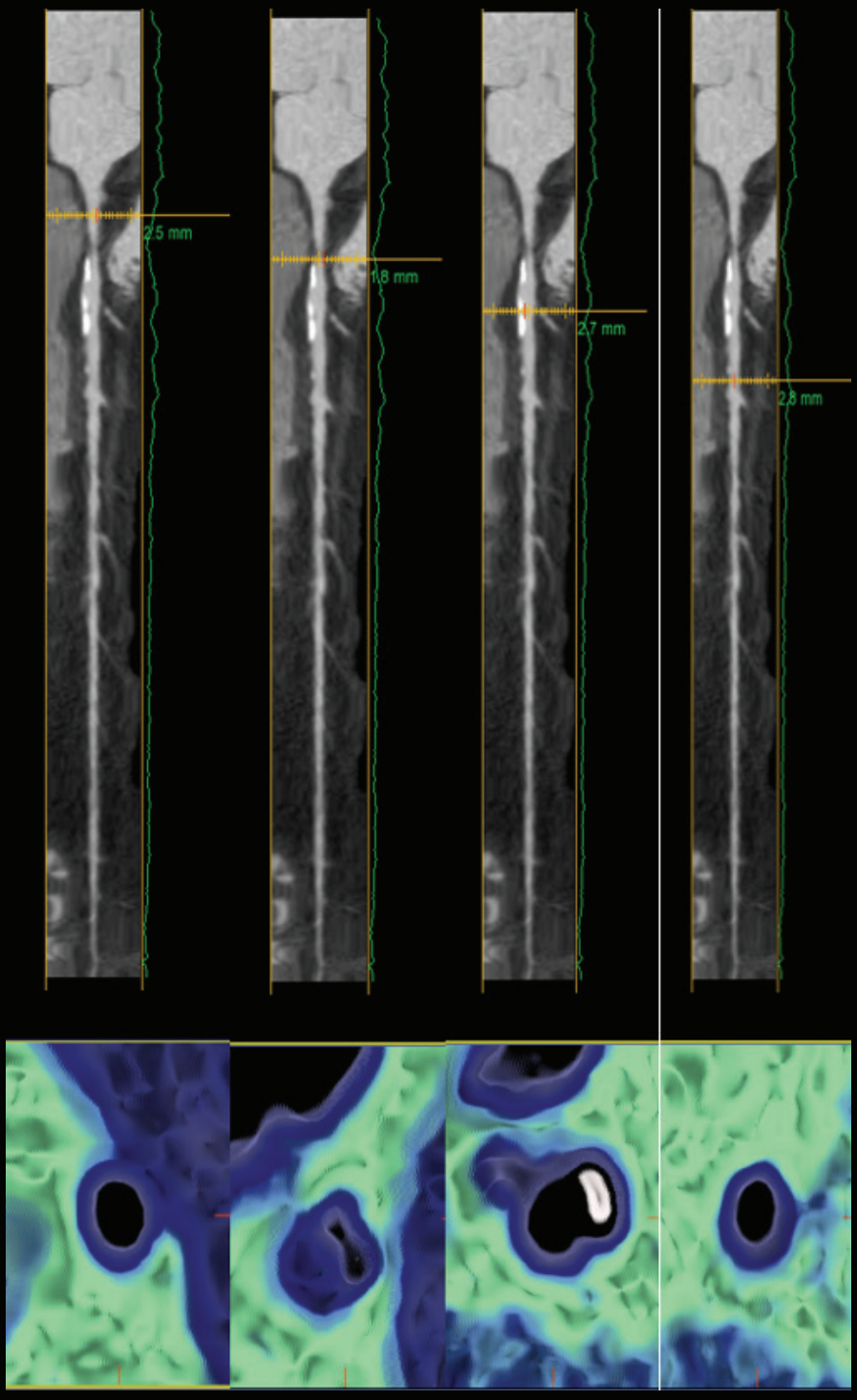


Figure 3. IVUS-like view can help to differentiate calcified from non-calcified plaques in the vessel wall

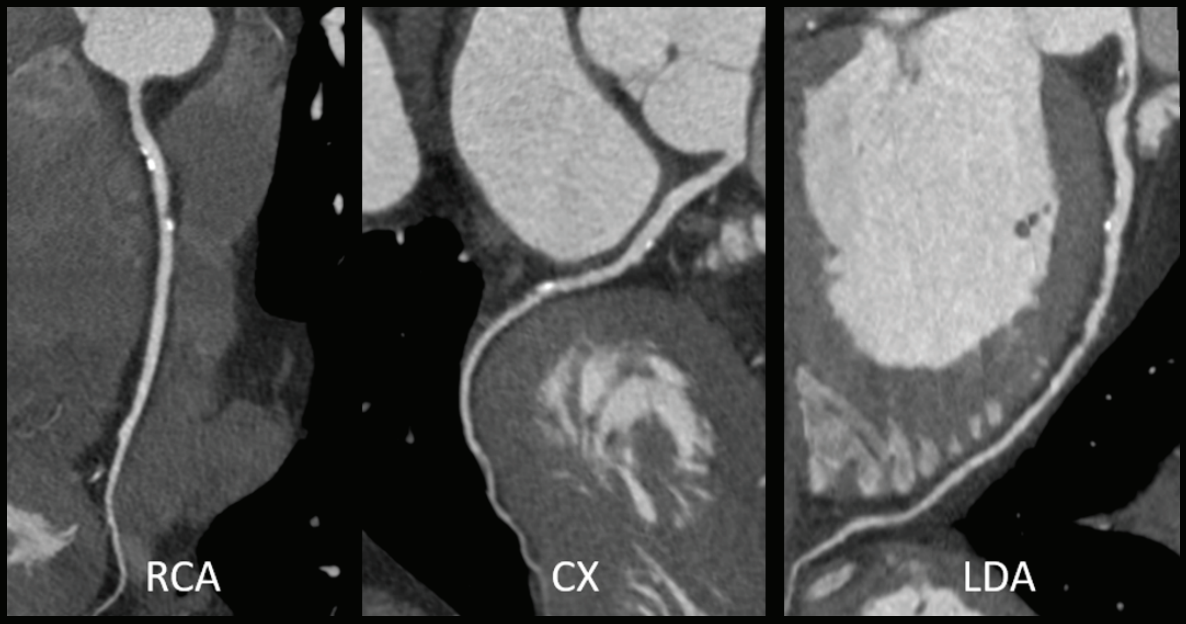


Figure 4. Curved Planar Reformation (CPR) showing coronary arteries. RCA: right coronary artery, Cx: Circumflex coronary, LAD: Left Anterior Descendent artery.

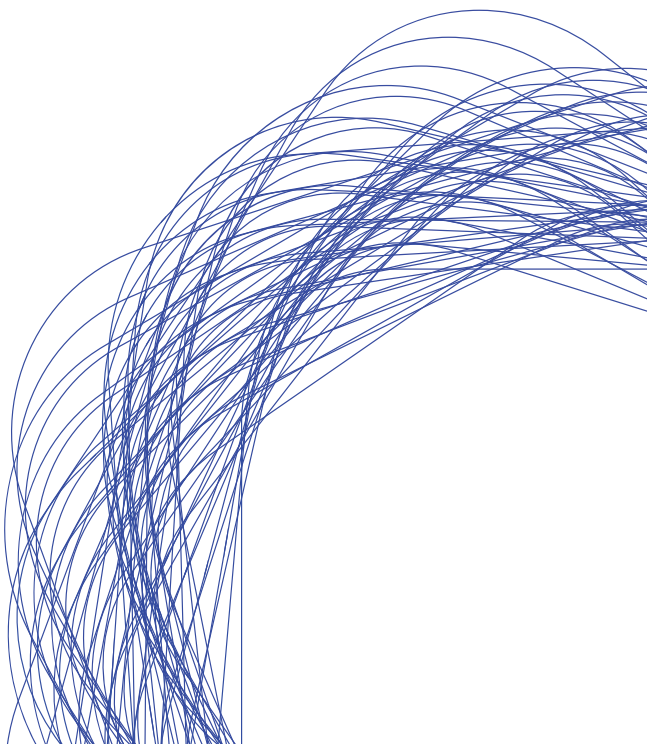
Clinical Summary

The calcified burden is showed by Coronary Calcium Score of 365, which places the patient in the percentile 65 after adjustment for ethnicity, gender, and age. Significant proximal LAD stenosis with detailed morphology showing vulnerable plaque characteristics were accessed. Also, moderate RCA stenosis was observed and the remaining coronary arteries segments with diffuse coronary atheromatosis, although with no significant luminal narrowing.

In this case, we were able to analyze coronary stenosis and plaque morphology with high resolution images and low effective radiation dose of 1.9mSv in an overweighted patient.

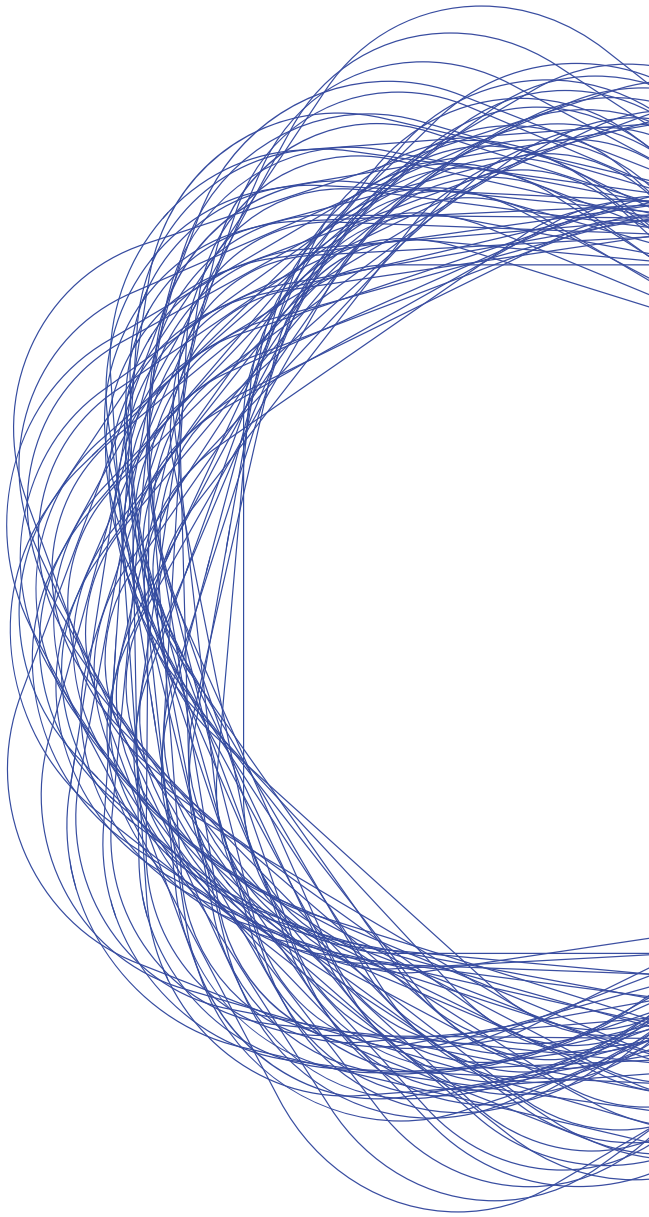
Key points/Conclusions

• **Revolution EVO enables high resolution prospectively ECG gated CCTA**, achieving high diagnostic confidence in the evaluation of coronaries.
• **Low radiation dose** can be achieved by using ASiR-V and Smart Dose technologies, As demonstrated in this clinical case, being **1.9mSv** effective radiation dose for an obese patient (BMI 26).
• Revolution **EVO's Clarity Imaging System** features the Performix 40 Plus tube with very **stable dual focal spots**, HiLight detector and low noise Clarity data acquisition system inherited from the Revolution CT.
• With the **IVUS-like** view (generated with CardIQXpress2.0), the user can color-code the HU units of the plaque to better visualize the difference between calcified and non-calcified plaque in the wall of the **vessel and the lumen to determine the amount of atherosclerosis**. The user can see the different valve planes along with a variety of new layouts to align the heart. The IVUS-like view is created by applying GE's Volume Rendering on a cross-section perpendicular to the detected centerline.



References:

https://www.gehealthcare.com/products/computed-tomography/revolution-evo-gen-3



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