High resolution Coronary Computed Tomography Angiography with Revolution EVO

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Summary

"In order to correctly evaluate accentuated Coronary Artheromatosis the acquisition of high-resolution images is extremely important. With our recently installed Revolution EVO CT Equipment, we are able to perform high image quality scans with low radiation dose and maintaining diagnostic confidence."

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Fleury Group

Fleury Group is one of the most respected medical and health organizations in Brazil. Its mission is to provide increasingly complete and integrated solutions for health management and people's well-being, with excellence, humanity and sustainability.

Case report

Introduction

We report a clinical case of a 71y old male patient, symptomatic, who underwent an exercise stress test, which showed signs of myocardial ischemia. Next, the attending physician ordered coronary angiography for assessing stenosis and correlation with the exercise test result.

The patient was admitted to our unit for asymptomatic coronary angiography, denying hypertension, diabetes, dyslipidemia, and a history of cardiac surgery or previous catheterization.

In accordance with the institutional protocol, the patient was referred to the preparation room and submitted to an electrocardiogram, which showed sinus rhythm and heart rate of 54 bpm, right upper limb venipuncture and hydration with glycophysiological serum. The patient then received guidance on the exam and was referred to the CT room. In addition, Isordil® 5mg was administered orally 10 minutes before initiating the exam. The use of beta blockers was unnecessary as the heart rate was adequate.

Acquisition protocol

Axial Slices with prospective cardiac trigger were acquired on our CT scanner **(Revolution Evo, GE Healthcare, Waukesha, Milwaukee, USA)** to assess the coronary calcium score. Subsequently, during intravenous injection of nonionic iodinated contrast, helical slices with retrospective cardiac trigger and dose modulation were performed.

The acquisition protocol is summarized in Table 1.

Images were pos processed with CardIQ on an Advanced Workstation (AW VolumeShare 7), a multi-modality medical image analysis platform.

Acquisition Protocol	Revolution EVO
Tube voltage [kV]	100
Tube current [mAs/rot]	385
Acquisition mode	Retrospective
Padding	40-80%
Scan length [mm]	113.4
Scan direction	Cranio caudal
Rotation Time	0.35
Scan time [s]	6 seconds
Slice collimation [mm]	0.625
Recon Increment	0.6
Slice width [mm]	0.625
Heart rate [bpm]	42-56
Recon kernel	Soft 50% with ASIR V
Contrast [mg/mL]	370
Contrast volume [ml]	70
Flow rate [mL/s]	5.0
Start delay	Visual / Manual
DLP	523
CTDIvol	35.15
Effective Dose [mSv] (anatomy + function)	7.3

Table 1. Acquisition protocol Revolution EVO CCTA

Revolution EVO

Exam Description: TCCORONARIAS

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Cine	I104.500-I242.000	4.47	62.63	Body 32
200	Axial	I164.322-I164.322	1.07	0.54	Body 32
201	Axial	I173.640-I173.640	10.71	5.35	Body 32
3	Cardiac Helical	I132.000-I246.000	35.15	523.81	Body 32
			Total Exam DLP:	592.32	

Table 2. Radiation Dose

CT findings

Angiography of the coronary arteries shows:

The coronary system was left dominant. Left coronary trunk with normal course and calibers, without significant luminal reduction. Anterior descending artery (LAD) bypasses the cardiac apex, has calcified and noncalcified plaques throughout the course, with a predominance in the proximal and middle segments, which determine significant stenoses. First diagonal branch (D1) of moderate expression, with partially calcified plaque and positive remodeling at the origin, which determines moderate stenosis. Second and third diagonal branches (D2 and D3) of small expression, without luminal reduction. Intermediate branch of small expression, with moderate partially calcified plaques predominating in the proximal and middle segments. Circumflex artery (Cx) with discrete partially calcified plaques in the proximal and distal segments. Marginal branches and posterior ventricular without stenoses. Posterior descending branch with densely calcified plaque at the origin, which determines at least moderate stenosis. Rest of vessel unobstructed. Right coronary artery (RCA) with partially calcified plaques along the entire path, which determine areas of slight luminal reduction. Right marginal branch without significant luminal reduction.

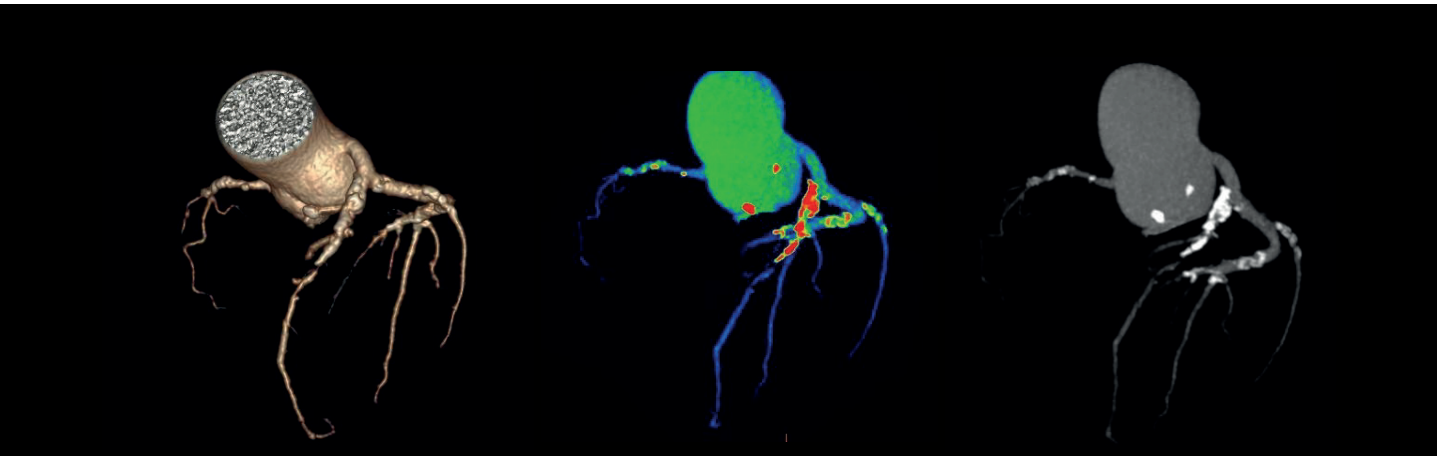

Figure 1. Left: VRT images, Middle: Color-coded image showing calcifications in red, vessel lumen in green. Right: angiographic view.

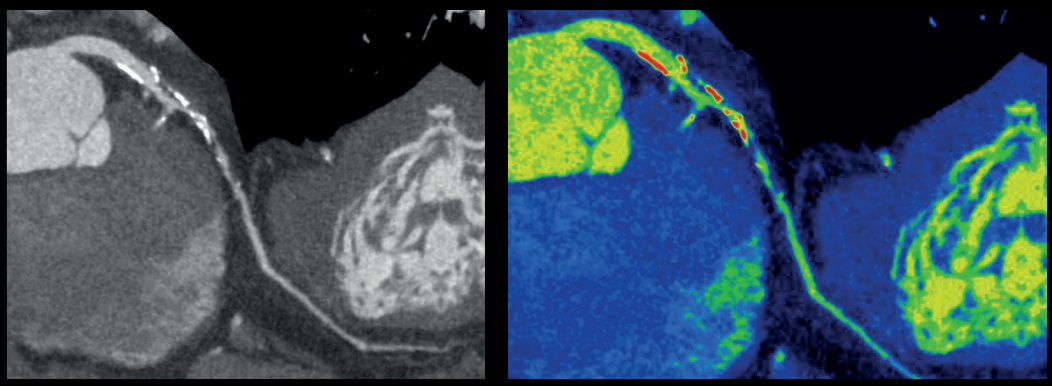

Figure 2.Left: LAD artery presenting calcified and noncalcified plaques throughout the course, important luminal reduction. Right: Color-coded image.

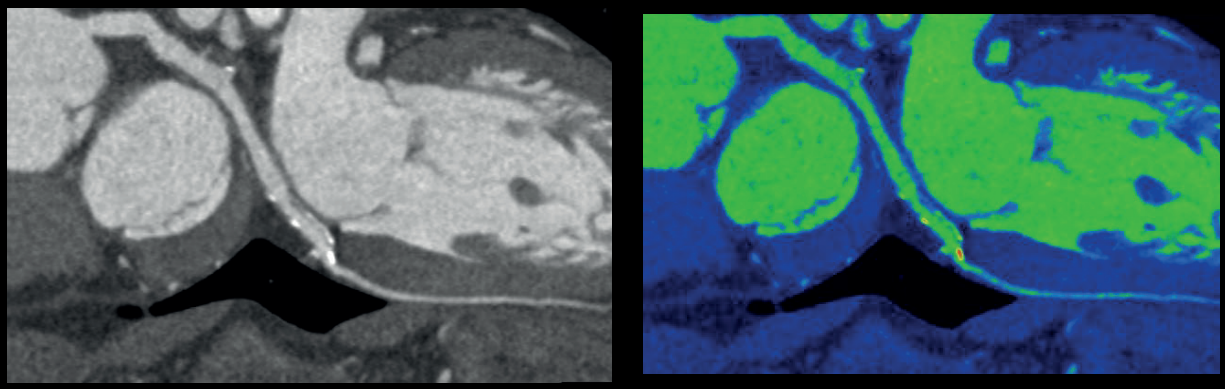

Figure 3 . Cx with discrete partially calcified plaques in the proximal and distal segments

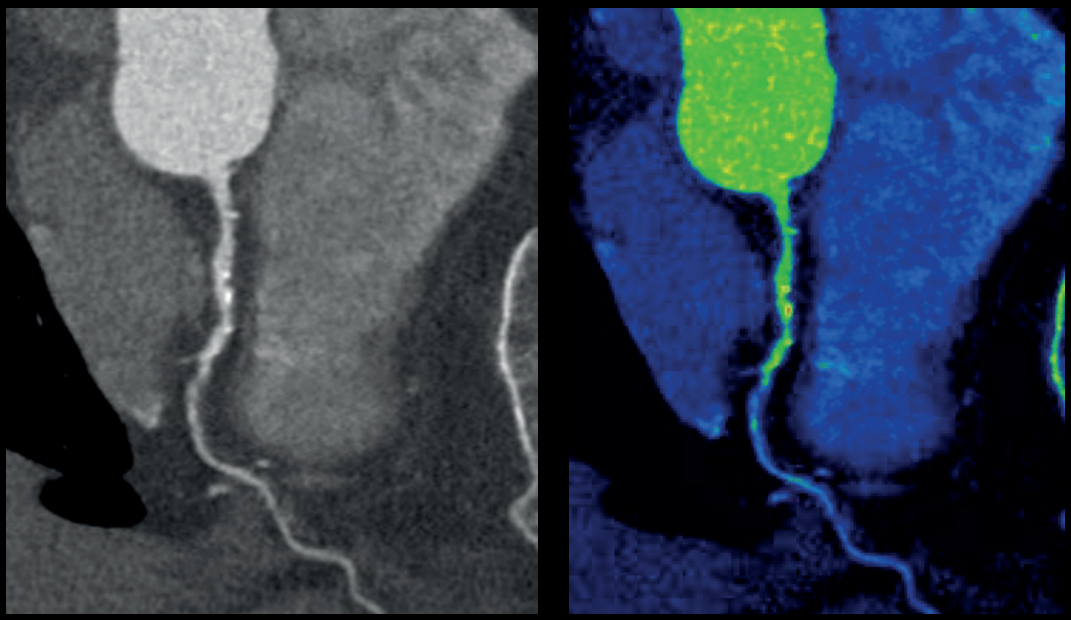

Figure 4. RCA with partially calcified plaques along the entire path, determining areas of slight luminal reduction.

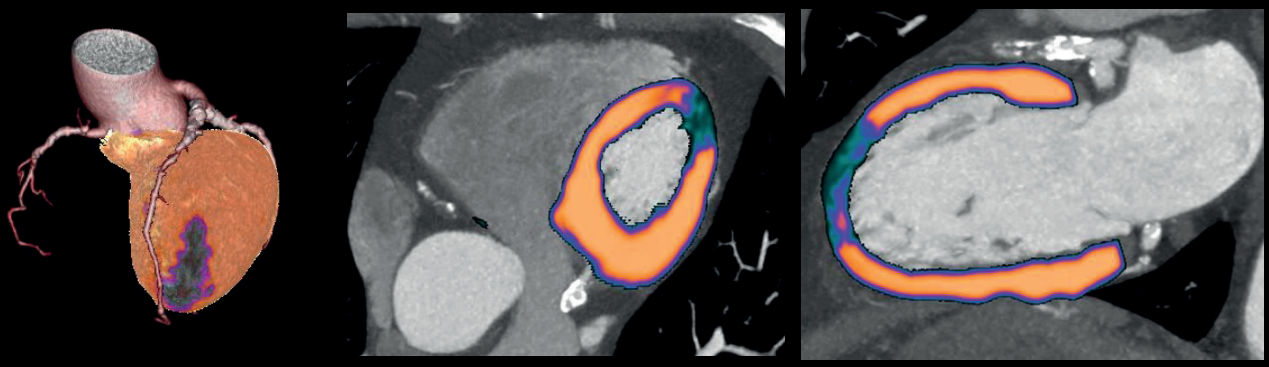

Figure 5. Reconstruction showing the relative perfusion defect in hypodensity area. Reconstruction was done with CardIQ Xpress Reveal 2.0.

Clinical summary

Accentuated Coronary Atheromatosis with coronary calcium score of 3074, which places the patient above the 90th percentile after adjustment for ethnicity, gender, and age. Areas of significant luminal reduction in the LAD and in the PD as described. Remaining CCTA of the coronary arteries without significant luminal reduction in the segments to be evaluated.

Despite the absence of symptoms reported by the patient in the present study, he presented signs of ischemia in the exercise stress test, which were confirmed after coronary angiography, showing significant stenosis.

Currently, with the new generation of multi-slice CT and post processing tools shown in the above figures, it is possible to obtain high resolution images with low doses of ionizing radiation, capable of achieving excellent diagnostic accuracy through multiplanar evaluation and vessel analysis reconstructions. In addition, postprocessing tools that illustrate the different densities of myocardial calcifications and areas of myocardial hypoperfusion are well correlated with functional tests. New technologies already available that will soon be included in our diagnostic routine, enriching the reports with more information and helping the assessment of the patient with arteriosclerosis, which will facilitate the therapeutic management of these cases.

Keypoints

• Revolution **EVO enables high resolution cardiac imaging**,achieving high diagnostic confidence in the evaluation of coronary arteries.

• CCTA acquistion can be done with **low effective radiation dose by ASiR-V and Smart Dose** technologies. As demonstrated in this clinical case, we could achieve in retrospective acquisition mode 7 mSv effective radiation dose for high resolution anatomic imaging with cardiac function. Important to note, it is possible to achieve as low as 1 mSv effective radiation doses with prospective aquisition mode without considering cardiac function.

• 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.

• Snap Shot Freeze (SSF) - Intelligent Motion Correction: **Image blurring** due to coronary artery motion can be **significantly reduced**. Vessel motion can be characterized by utilizing adjacent cardiac phases, and determination of actual vessel position at Rx'ed target phase and by adaptively compensation for residual motion at that phase.

About the Author

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