



# Revolution CT Reduces Total Cost of Care in Emergency Chest Pain Patients

Cardiac CT angiography (CCTA) is an established technique for the evaluation of coronary artery disease (CAD). The American College of Cardiology Foundation, in conjunction with other key specialty and subspecialty societies, released appropriate use criteria for cardiac CT in 2010 that states, “assessment in patients with low or intermediate risk or pretest probability for coronary artery disease was viewed favorably.”<sup>1</sup>

Several efficacy studies have found CCTA to be an efficient and safe assessment of patients with acute chest pain and low to intermediate likelihood of CAD. Yet, questions linger regarding the value and effectiveness of CCTA in other patient groups and scenarios, including patients with acute chest pain and patients with symptoms suggestive of stable angina.<sup>2</sup> There is also an effort underway to identify new imaging and biological factors that can help identify high-risk features in patients that may be associated with the earliest markers of subclinical atherosclerotic disease: the Miami Heart Study at Baptist Health South Florida (MiHEART).<sup>3</sup>

Led by Ricardo C. Cury, MD, FSCCT, Medical Director of Cardiac Imaging at Baptist Hospital and Miami Cardiac & Vascular Institute, MiHEART is a prospective, population health study

of asymptomatic patients. All participants undergo a very detailed screening, including cardiac risk factors, physical exam, lipid panel, EKG, advanced proteomics and genomics blood analysis and an ultra-low-dose CCTA enabled by Revolution™ CT. Currently, just over half of the target 4,000 subjects have been enrolled.

Although Revolution CT provides several advancements for CCTA, there is one that is most important for asymptomatic patients: radiation dose. Revolution CT includes GE’s latest generation iterative reconstruction (IR) algorithm, ASiR-V™, which delivers up to 82% less dose.<sup>4</sup>

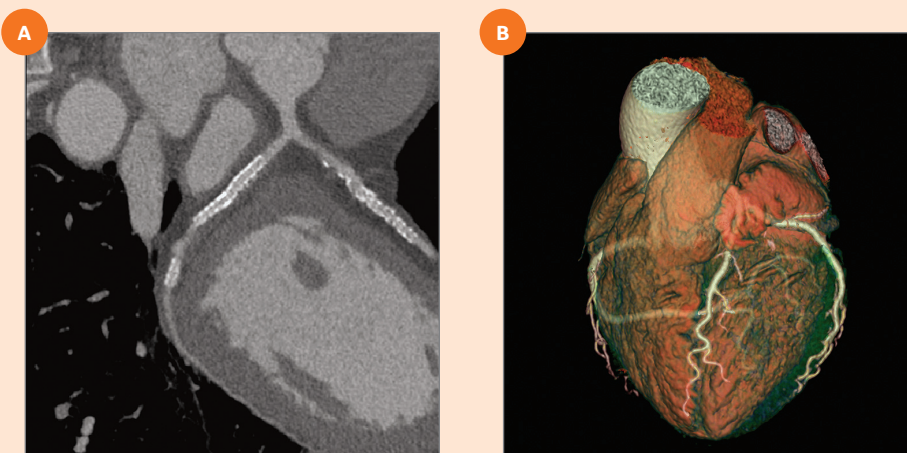
“We are using a low-dose protocol, and having Revolution CT allows us to use it and still obtain good image quality with diagnostic confidence,” Dr. Cury says. While the dose ranges across patients based on body habitus and body mass index (BMI), Dr. Cury says the target dose is between 1-2 mSv, with many patients receiving less than 1 mSv.

Low-dose CT is commonly utilized at West Kendall Baptist Hospital where Revolution CT is installed. Dr. Cury recently conducted a survey of radiologists using a five-point Likert scale to evaluate image quality and diagnostic confidence with

low-dose CT imaging across the health system. He found that when reading studies generated by Revolution CT, the majority of radiologists reported they agree or strongly agree that both diagnostic confidence and image quality increased since installation of the system.

## Chest pain protocol research

Dr. Cury, and under his direction, clinicians throughout Baptist Health South Florida,



**Figure 1.** CCTA images of challenging patients (high heart rate and/or arrhythmia) captured on Revolution CT at West Kendall Baptist Hospital.



have been trailblazers in the use of CCTA, particularly for the evaluation of patients presenting to the emergency department (ED) with chest pain. Based on the CCTA results, a patient with no or mild, non-obstructive disease is discharged; a patient with an intermediate lesion is first tested for ischemia; if a lesion is found, the patient is sent to the cath lab for intervention.

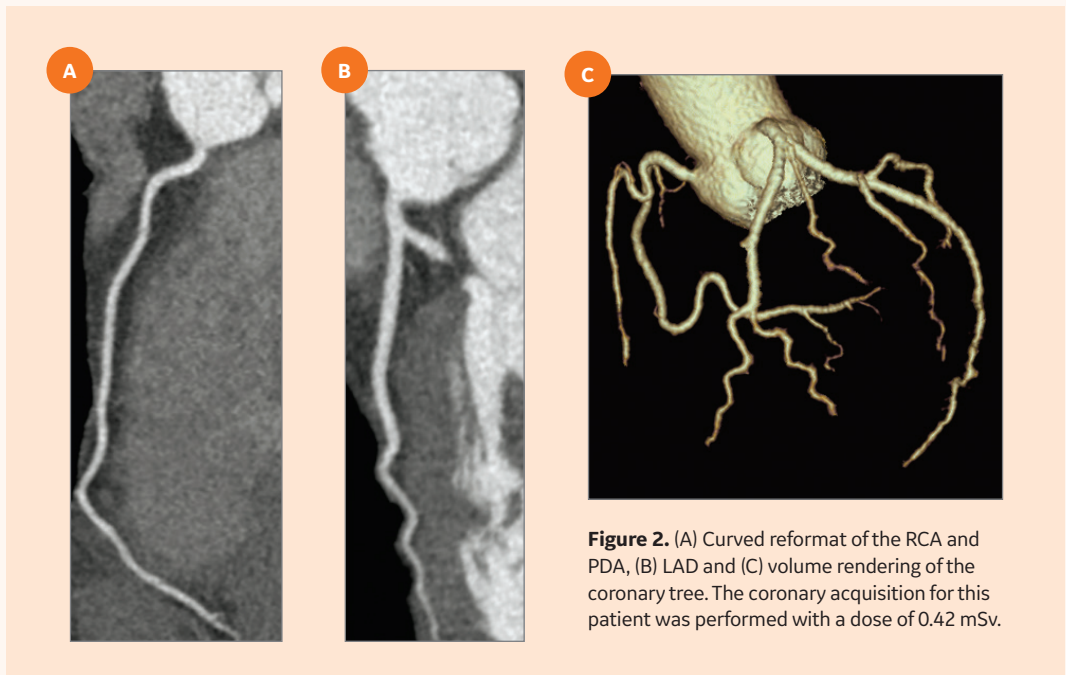
In a 2013 published study using this protocol on Revolution CT, Dr. Cury and colleagues reported

a positive clinical and financial impact of a dedicated CT patient management protocol in the ED. The study reported a 50% decrease in length of stay (LOS), a very low rate for major adverse cardiac events (MACE) with a negative predictive value of 99.8%, and a 58.3% decrease in effective radiation dose using ASiR.<sup>5</sup>

At West Kendall Baptist Hospital, Revolution CT is a primary diagnostic tool used to triage patients presenting to the ED with chest pain. Dr. Cury is now looking to collect additional data and expand the ED chest pain protocol to higher risk patients. Currently, patients deemed to be high-risk are referred for a functional stress test.

“With Revolution CT we are testing a new strategy; to ascertain if we see improved overall diagnostic accuracy and reduced length of stay and total cost of the episode of care by combining CCTA with stress myocardial perfusion CT and expanding its use to high-risk patients,” Dr. Cury says.

The results so far look encouraging, he adds. Initial analysis suggests that LOS and costs decrease, and there is a lower number of false negatives with the combined CTA and stress



**Figure 2.** (A) Curved reformat of the RCA and PDA, (B) LAD and (C) volume rendering of the coronary tree. The coronary acquisition for this patient was performed with a dose of 0.42 mSv.

myocardial perfusion CT. Dr. Cury and colleagues have submitted an abstract and hope their study will be accepted for publication in the upcoming year.

“This approach would be very valuable for the intermediate and high-risk patient,” he says. “We can really expand the patient population that could benefit from this combined strategy.”

### Imaging challenging patients

West Kendall Baptist Hospital was one of the sites that provided data for GE Healthcare’s Revolution CT FDA submission. As such, Dr. Cury had the opportunity to image and evaluate numerous challenging patients with high heart rates and cardiac arrhythmias.

“We’ve had a great experience using Revolution CT in high heart rate patients,” he explains. He shares there have been several cases with patient heart rates in the 80-90 bpm range where they proceeded with a CCTA without beta blockers and obtained diagnostic image quality.

“ Providing a more accurate and confident diagnosis helps minimize downstream testing. ”

Dr. Ricardo C. Cury



“With Revolution CT, we can achieve robust image quality in patients with high heart rates, which improves the workflow and can reduce additional downstream diagnostic tests,” he adds. “The one-beat acquisition is just amazing; the ability to capture the entire heart, regardless of heart rate, is impressive.”

In fact, Dr. Cury has been collecting data on the diagnostic quality of studies performed on challenging patients using Revolution CT. Previously, across the various systems installed at all Baptist Health hospitals, approximately 5% of CCTA cases in patients with high heart rates were considered non-diagnostic quality. However, when Revolution CT was utilized for these types of patient cases, Dr. Cury says greater than 99% were diagnostic quality.

“Dropping to less than 1% non-diagnostic quality in high heart rate patients is a significant achievement,” he adds.

In another study of 30 patients with atrial fibrillation, Revolution CT again delivered amazing results. Twenty-seven, or 90%, of these patients had diagnostic-quality studies.

“Before, these patients would generally be contra-indicated, so we would not perform the CCTA,” Dr. Cury says. “Revolution CT has definitely opened the door for performing this exam on these patients with a good image quality to make a diagnosis.”

West Kendall Baptist Hospital regularly utilizes Smart Cardiac technologies—One-beat AutoGating, SmartPhase and SnapShot™ Freeze—in CCTA studies. Dr. Cury reports an improved workflow with AutoGating, which identifies the ideal time within the heart cycle to scan the whole heart in a single beat at any heart rate, and SmartPhase, which automatically selects the best phase with the least coronary motion for reconstruction. SnapShot Freeze enhances image quality by minimizing motion artifacts, particularly in the right coronary artery. The improvement in workflow and enhancement in image quality also translates to streamlined reconstruction of the imaging data and higher diagnostic confidence for the radiologists.

## Beyond the coronaries

Beyond CCTA, Revolution CT is enabling lower dose in triple-rule out studies. Dr. Cury explains that with a fast 2-second acquisition, the hospital is able to decrease the amount of contrast, as well as the amount of radiation dose used in a triple-rule out patient study.



**Figure 3.** (A) Curved reformat of the RCA and posterior left ventricular branches and (B) LAD show two calcified lesions. The cardiac series on this exam was performed at a dose of 0.18 mSv. The entire exam was performed with a dose of 0.85 mSv and included scouts, calcium score series, timing bolus series and the enhanced cardiac series.

“We have achieved a more robust protocol that is also more reliable for evaluating the aorta, coronaries and pulmonary arteries,” Dr. Cury says. In cases of dedicated chest CTAs for aortic dissection, he estimates only 1-2% have sub-optimal results with Revolution CT. When CT imaging is used for surgical planning and 3D printing, there is a clear advantage to using a volumetric scanner such as Revolution CT—it achieves a perfect 1:1 translation of the anatomy to the 3D printing model.

Being the first site in South Florida with a Revolution CT has delivered financial benefits to the health system as well. “Providing a more accurate and confident diagnosis helps minimize downstream testing,” Dr. Cury says. “We’ve attracted new patients from other cities, so that has been positive in terms of new growth for our healthcare system.” ■

### References

1. Taylor AJ, Cerqueira M, Hodgson JM, et al. ACCF/SCCT/ACR/AHA/ASE/ASNC/NASCI/SCAI/SCMR 2010 Appropriate Use Criteria for Cardiac Computed Tomography. *Circulation*, 2010; 122:e525-e555.
2. Hetterich H, Nikolaou K, Reiser MF, Bamberg F. The Big Picture: Evidence Base and Current Clinical Trials in Cardiac CT. *Curr Radiol Rep*, 2013; 1:246-254.
3. The Miami Heart Study at Baptist Health South Florida (MIHEART). Available at: <https://clinicaltrials.gov/ct2/show/NCT02508454>. Accessed on April 24, 2017.
4. In clinical practice, the use of ASIR-V may reduce CT patient dose depending on the clinical task, patient size, anatomical location and clinical practice. A consultation with a radiologist and a physician should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.
5. Cury, RC, Feuchtner GM, Batlle JC, et al. Triage of Patients Presenting With Chest Pain to the Emergency Department: Implementation of Coronary CT Angiography in a Large Urban Health Care System. *American Journal of Roentgenology*. 2013;200:57-65.