A Pictorial Review of Coronary Artery Anatomy on Spiral CT*

David N. Rabin, MD; Steven Rabin, MD; and Richard A. Mintzer, MD, FCCP

Coronary artery calcification quantification (scoring) has been done with electron beam CT (EBCT), but is now being done with spiral or helical CT. Many radiologists and cardiologists who do not have EBCT but do have access to spiral CT will now be able to do coronary artery calcification scoring, and will now need to know the spiral CT appearance of the coronary artery anatomy. This pictorial review will demonstrate the anatomy needed for coronary artery calcium scoring.

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Abbreviations: EBCT = electron beam CT; LAD = left anterior descending artery; LCX = left circumflex artery; LMA = left main coronary artery; PDA = posterior descending artery; RCA = right coronary artery

Electron beam CT (EBCT) has been used for years to quantify coronary artery calcification, although the clinical utility of screening for coronary artery calcification is still controversial. Coronary artery calcification quantification is now starting to be done with spiral CT technology. Spiral CT for coronary artery calcification scoring will change this formerly esoteric technique into a common and perhaps almost universally available screening test. Knowledge of coronary artery anatomy as seen on spiral CT is now becoming important to radiologists and cardiologists, since spiral CT is commonly available and EBCT is expensive and has limited availability. This review article will demonstrate the coronary artery anatomy as seen on spiral CT. The images have been obtained with a CT/i Spiral CT scanner (General Electric; Milwaukee, WI). These images demonstrate the image quality that can be expected from routine spiral CT evaluation of the coronary arteries using special cardiac imaging software (Smartscore; General Electric).

Evaluation of the coronary arteries is performed with images from near the carina of the lung to the bottom of the heart. Each rotation of the scanner attempts to capture data for one 3-mm image. The acquisition technique is selected as a function of heart rate and CT-scanner rotation speed, such that the table advances by 3 mm in each heartbeat. From the acquisition images, the software creates reconstructed images every 0.1 s or 0.3 mm, so that 10 reconstructed images span each cardiac cycle. The study is retrospectively gated with the patient’s ECG, which was obtained during the image acquisition. Diastolic images are selected from the reconstructions, so that images used in coronary artery calcification scoring have the least amount of motion, since motion blurring would increase the apparent size and score of calcium. Heart rates > 90 beats/min are currently not scanned. Misregistration artifact is decreased by acquiring the images in the same part of the cardiac cycle.¹

Coronary artery calcification quantification is then performed on selected diastolic reconstructions using Smartscore at a workstation. Early reports indicate that coronary artery calcification quantification of retrospectively cardiac gated spiral CT are highly correlated with the results obtained from EBCT.²
Coronary artery calcification scoring requires a thorough understanding of the anatomy of the coronary arteries that are evaluated in the study. Coronary artery calcium quantification is performed for the left main coronary artery (LMA), left anterior descending artery (LAD), left circumflex artery (LCX), right coronary artery (RCA), and the posterior descending artery (PDA). These are all easily recognized using these special spiral CT techniques. We trace each individual coronary artery from its origin to the inferior aspect of the heart on contiguous images.

The first coronary artery seen (starting superiorly from its origin) is the LMA. The LMA arises from the left sinus of Valsalva (Fig 1) and courses to the left posterior to the main pulmonary artery. The LMA bifurcates into the LAD and the LCX (Fig 2). The LAD runs anteriorly in the anterior interventricular groove. The LAD gives off septal and diagonal branches (Fig 3), and we quantify the calcium seen in branches of the coronary arteries. Septal or diagonal calcium would be counted as calcium in the LAD. The LCX runs to the left and inferiorly in the posterior atrioventricular groove (Fig 4). The LCX gives off marginal branches, which supply the left ventricle.

The RCA originates more caudally from the aorta than the LMA. The RCA arises from the right sinus of Valsalva (Fig 5). The RCA runs anteriorly and to the right, and then courses inferiorly. The RCA runs in the anterior atrioventricular groove. The RCA and LCX can be followed inferiorly toward the apex of the heart (Fig 6, top and bottom).

The PDA usually arises from the RCA. Coronary artery dominance is defined by which coronary artery gives rise to the PDA. The RCA is dominant in 70% of people with the RCA giving rise to the PDA (Fig 7). In 10% of people, the left coronary artery is dominant, and the LCX reaches the crux of the heart and continues as the PDA. In 20% of people, there is a balanced system in which the RCA gives rise to
the PDA, but the LCA also supplies branches which supply this area of the left ventricle. The LCA supplies the majority of blood to the left ventricle, even in people who have a right dominant system.

The PDA extends to the apex of the heart in the posterior interventricular groove, and frequently meets branches of the LAD at the apex of the heart.

There are potential pitfalls when using CT to evaluate coronary artery anatomy. The LAD may extend above or in a cephalic direction, so that portions of the LAD may be more cephalic than the LMA (Fig 8). If this is not recognized, then calcification in this part of the LAD will not be scored, resulting in a score that is incomplete and potentially misleading. Coronary veins may be confused with coronary arteries (PDA; Fig 9) at the caudal aspect of the heart. These vascular structures, however, can be traced back to the coronary sinus on contiguous images, proving that they are veins.

Spiral CT can demonstrate coronary artery anatomy and can demonstrate coronary artery calcification (Fig 5) when the coronary artery anatomy is understood.
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Figure 9. RCA gives rise to the PDA, which demonstrates minimal calcium (curved arrow), and the PDA is adjacent to a coronary vein (arrow) in a 49-year-old man.