Editorial

Evaluation of Coronary Stent by Cardiac Computed Tomography

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Percutaneous management of coronary artery disease (CAD) has evolved substantially with the introduction of coronary stents[1]. Today, coronary angioplasty with stent implantation accounts for the overwhelming majority of procedures (more than 80%). The use of drug-eluting stents[2] in multivessel disease further increases the number of implanted stents.

Concurrent with this phenomenon, cardiovascular computed tomography (CCT), particularly multidetector CT (MDCT) coronary angiography, has led to increasingly frequent detection of CAD, thereby augmenting the use of percutaneous treatment.

Stent implantation is expected to reach unprecedented levels. Although restenosis rates have declined with the advent of drug-eluting stents, the great number of stent implantations and the still current use of bare-metal stents, especially by the Brazilian public health system (SUS), make restenosis a major clinical problem.

In spite of the fact that other non-invasive methods for diagnosing myocardial ischemia (functional methods) are available, none of them is able to locate the coronary disease anatomically or discriminate - in stented patients - between stenosis within the stent and at its margins. At present, CCT is the only non-invasive method that can define CAD anatomically (anatomical method) and, thereby, locate it accurately within the coronary tree.

In this context, the work of Pinto et al[3] assumes great importance. The primary results of their study, one of the first of its kind in Brazil, are the quantitative aspect and the use of intravascular ultrasound and a single type of stent. A well-controlled and well-conducted study, it shows the potential of the new CCT technology. A limitation of the study refers to the use of first-generation MDCT scanners, with only four rows of detectors. Paradoxically, this limitation actually turned out to be a strength in this pioneering study, since it shows the potential offered by the current 64-row scanners.

Recently, we participated in the development of the first Brazilian guidelines for cardiovascular magnetic resonance imaging and computed tomography (CMR and CCT) of the Brazilian Society of Cardiology, conducted by the GERT, Grupo de Estudos de Ressonância e Tomografia. During this intense yet pleasurable work, the issue of how to rank CCT indications for assessing coronary stents was marked by a great deal of debate. Several distinguished cardiologists, who assisted the CCT experts, strongly favored the IIa classification, that is to say, suggesting that the body of available information and opinion support this clinical indication. Even though in the final table this indication has been ranked as IIb, I believe that, in the symptomatic patient, it could potentially be considered as IIa level, given the tremendous technological advances offered by 64-slice CT scanners[4]. This discussion emphasizes the importance of the quantitative data presented by Pinto et al[3].

In fact, the ability of new scanners to detect in-stent stenosis depends on a range of technical aspects, such as the type and design of the metal alloy the stent is made of, stent final diameter and expansion, the X-ray beam angle relative to the stent, spatial resolution (now with an isotropic voxel size of 0.35 mm^3), acquisition and reconstruction techniques (such as the convolution kernel that controls the signal-to-noise ratio), contrast agent concentration, X-ray tube capacity, and heart rate and frequency at the time of image acquisition, among others. Depending on how well these factors act together, in-stent luminal images may be accurate or hampered by artifacts, particularly the blooming effect and intraluminal dark images mimicking neointimal hyperplasia, but that are, in fact, the result of beam hardening.

New developments, such as an increased number of detector rows and multiple X-ray sources, as well as acquisition and reconstruction algorithms to enhance coronary stent visualization, will further improve the ability of these devices to evaluate in-stent stenosis.

Currently, higher quality CT scans allow visualization of more than 50% of the stent lumen of the vast majority of the commercially available stents. Based on my experience, I am even more optimistic. In high-quality examinations, I have been able to visualize 80% to 90% of in-stent lumen.

In a recent editorial[5], I attempted to answer the question faced by all cardiologists: Can CCT already be indicated for diagnosing in-stent restenosis? Generally speaking the answer was yes. However, I warned that a great deal of information about cost-effectiveness remains lacking in the literature. Despite my optimism, it is worth noting that recent papers suggest that CCT use should be viewed conservatively. The first paper reports on a multicenter study using 16-detector-row scanners[6] that, despite confirming this technology's negative predictive value (a negative examination virtually rules out the presence of major obstructive coronary disease), highlights the risk of a high number of false positives that would ultimately increase the number of procedures and costs. My criticism of this study is that segments that could not be evaluated were considered positive for obstructive disease, which seems both overly strict and unrealistic in clinical practice. Additionally, a multicenter, multinational study on the superior technology of 64-slice CT scanners, already in routine use, is in its final

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phase and may provide new information on the best available technology. The second paper, reflecting the opinion of American specialists in CCT and CMR[7], deemed inappropriate the indication of stent evaluation by CCT in asymptomatic patients and uncertain in symptomatic patients. I agree that, in the asymptomatic patient for whom functional tests did not suggest ischemia, there is no reason for routine stent evaluation. Nevertheless, in case of equivocal or suggestive signs of obstructive CAD, CCT may be beneficial.

Therefore, despite all doubts and controversies, the sound judgment and knowledge of appropriately trained professionals will allow us to make the best of this technology, to the advantage of our patients today, without causing any harm by its excessive or indiscriminate use.

References

1. Rankin JM, Spinelli JJ, Carere RG, et al. Improved clinical outcome after widespread use of coronary-artery stenting in Canada. N Engl J Med. 1999;341:1957-65.
2. Sousa JE, Costa MA, Abizaid A, et al. Lack of neointimal proliferation after implantation of sirolimus-coated stents in human coronary arteries: a quantitative coronary angiography and three-dimensional intravascular ultrasound study. Circulation. 2001;103:192-5.
3. Pinto IMF, Sousa AGMR, Ishikama W, et al. Avaliação tardia de endopróteses coronarianas com sirolimus: comparação da tomografia computadorizada por múltiplos detectores com a angiografia quantitativa e o ultra-som intracoronariano. Arq Bras Cardiol. 2006; 87: 575-82.
4. Seifarth H, Ozgun M, Raupach R, et al. 64-versus 16-slice CT angiography for coronary artery stent assessment: in vitro experience. Invest Radiol. 2006;41:22-7.
5. Rochitte CE. Angiotomografia *multislice* no diagnóstico de reestenose de *stent*. Já podemos indicar? Rev Bras Cardiol Invas. 2005;13(1):10-1.
6. Garcia MJ, Lessick J, Hoffmann MH. Accuracy of 16-row multidetector computed tomography for the assessment of coronary artery stenosis. JAMA. 2006;296:403-11.
7. Hendel RC. ACCF/ACR/SCCT/SCMR/ASNC/NASCI/SCAI/SIR appropriateness criteria for cardiac computed tomography and cardiac magnetic resonance imaging. J Am Coll Cardiol. 2006;48(7). Electronic Citation: http://www.acc.org/qualityandscience/clinical/pdfs/CCT.CMR.pdf