Should We "Absorb" the Concept of 3D Quantitative Coronary Angiography in the Catheterization Laboratory?

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Conventional, invasive, two-dimensional coronary angiography has evolved over the years as a reliable, useful and accurate method for estimating coronary artery size and for diagnosing obstructive coronary atherosclerosis. However, real-time qualitative assessment of coronary vessels, even by experienced operators, may result in inaccuracies [1]. This suboptimal accuracy is often seen in revascularization studies where the interventional cardiologist's assessment of vessel size or degree of coronary artery stenosis may be different from that diagnosed by a more accurate offline vessel assessment tool using dedicated software (two-dimensional quantitative coronary angiography, 2D-QCA) [2]. To improve the accuracy of coronary diagnosis, several modalities have been developed over the years, including intravascular ultrasound (IVUS) and optical coherence tomography (OCT) [3,4]. These are used in clinical practice but require time and expertise and are associated with substantial cost. Moreover, the invasive nature of these ancillary imaging modalities, which are based on coronary wire manipulation and carry a minor risk of complications, has led to a search for alternative methods for coronary diagnosis such as three-dimensional coronary angiography (3D-QCA), which may improve diagnostic accuracy without the additional cost associated with ancillary imaging.

3D-QCA may overcome some of the shortcomings of 2D analysis and might provide more reliable information than that derived from conventional 2D angiograms [5,6]. This involves combining at least two separate two-dimensional angiographic views, thus overcoming the foreshortening inherited in 2D imaging which may result in different vessel sizes or different bifurcation angles when recorded from different angiographic views.

An important method of 3D-QCA technology was developed in Israel and was tested in several patient populations. The software incorporates data from at least two angiographic views and allows assessment of vessel size (diameter or cross-sectional area) and measurement of the bifurcation angle between the main and side branches. It was also recently shown to be clinically useful for measuring the left main stem bifurcation angle, which is an important determinant of patient outcome following left main percutaneous coronary intervention (PCI) [7,8]. The accuracy of 3D-QCA was also previously tested against IVUS as the reference standard and was shown to be accurate for assessment of cross-sectional areas including in the left main coronary artery [9]. However, the true value of 3D-QCA in clinical practice remains unclear. Despite the fact that this technique requires offline measurements, the analysis process is relatively short and may be performed quite rapidly in the catheterization laboratory. Given the low penetration of this technique into catheterization laboratories in recent years, it is indeed interesting to explore which patient groups may derive clinical benefit from 3D-QCA.

In an attempt to answer this clinical question, at least partly, Witberg et al. [10] explored the usefulness of 3D-QCA in patients undergoing implantation of bioresorbable everolimus-eluting vascular scaffolds (BVS) and present their findings in the current issue of *IMAJ*. While the concept of BVS, which resorb over time and do not leave any physical remnants within the coronary lumen, was highly attractive when initially introduced, preliminary reports of higher rates of target vessel failure, especially stent thrombosis, led to a thorough assessment of the implantation techniques. It became evident that accurate sizing is mandatory in the setting of BVS implantation, probably even more important than what is required for implantation of conventional new-generation metallic drug-eluting coronary stents. Subsequent BVS studies confirmed that this technique is now feasible and has an acceptable safety profile [11]. In the current study, Witberg and co-authors evaluated 17 patients enrolled in BVS (Absorb) randomized trials at their institution. They evaluated scaffold sizing in these patients with either 2D-QCA or 3D-QCA and compared the results with the QCA data analyzed by the study core lab that served as the reference. The authors found that 3D-QCA had a much better agreement with core lab data than 2D-QCA and significantly decreased the number of patients in whom scaffold sizing was judged to be inadequate according to BVS sizing study recommendations. In addition, the authors report the 2 years event rate observed in these 17 patients. Two of the 17

(12%) had an adverse event (stent thrombosis resulting in myocardial infarction in one, and the need for revascularization but not due to BVS site restenosis in the other). While the study cohort is too small to allow meaningful conclusions with regard to BVS efficacy or safety profile, the authors should be commended for their thorough investigation of the coronary vessel anatomy and for demonstrating the usefulness of 3D-QCA in this setting. Although IVUS or OCT was not used in the current study routinely or as reference standards, and despite the fact that these modalities are frequently used for better assessment of coronary artery size and plaque distribution before BVS implantation, the use of core lab offline QCA reference data is a good and acceptable standard for accurate sizing.

So, should we use 3D-QCA routinely before BVS implantation or perhaps before any conventional stent implantation? To answer this question, one should consider what may be useful in the catheterization laboratory. It seems that 3D-QCA is not necessarily needed for conventional stent implantation given the low adverse event rate observed with currently available new-generation drug-eluting stents. However, despite the infrequent use of BVS in clinical practice in general, and in Israel in particular, it seems that the concept of ancillary imaging or image post-processing (with 3D-QCA) should be incorporated routinely into the catheterization laboratory workflow, especially in cases where accurate sizing becomes a critical issue, such as the case of BVS PCI.

Although some operators will still continue to use IVUS or OCT before and/or after BVS implantation to allow better assessment and possibly a safer outcome, the 3D-QCA concept which allows acquisition of reliable information without additional instrumentation and without additional procedural cost or risk, while requiring only a few computer mouse clicks, is definitely appealing. Therefore, it does make sense to "absorb" this technology into clinical practice in some scenarios, especially if it can be done in a streamlined fashion in the catheterization laboratory and not only as part of a research protocol. The same rationale might hold true for conventional stent implantation, but its clinical usefulness in this scenario and whether this type of imaging can increase procedural safety remains to be seen.

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