EDITORIAL COMMENT

Anatomical and functional assessment of coronary artery disease: The search for the perfect protocol[☆]

Avaliação anatómica e funcional na doença coronária: em busca do protocolo perfeito

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Recent years have seen increasing use of cardiac computed tomography (CT) and cardiac magnetic resonance imaging (CMR) in clinical practice. This reflects impressive technological advances in cardiac imaging, which have made these modalities reliable tools in the assessment of cardiovascular disease, together with reports of their clinical usefulness, particularly concerning coronary artery disease (CAD).

In the case of cardiac CT angiography (CCTA), in which advances in the last 10 years have been most marked, this rapid technological development has led to significant improvements in spatial and temporal resolution, as well as progressive reductions in radiation dose, which in turn have led to increasing integration of these modalities into diagnostic protocols for assessing patients with suspected CAD.

The work published in this issue of the *Journal* by Ramos et al.[1] makes an important contribution to understanding the role of these cardiac imaging techniques, and is part of a line of research that this group has been following for some years.[2,3] The authors are to be congratulated on the design of their study, in which 101 patients were systematically assessed by an integrated protocol that includes anatomical study by CCTA and functional assessment by CMR myocardial perfusion imaging, as well as by coronary angiography complemented by measurement of fractional flow reserve (FFR). The latter is considered the gold standard to evaluate the physiological significance of coronary stenoses, identifying lesions that are causing ischemia and will benefit from revascularization,[4] and, more importantly, gives valuable prognostic information on lesions that have no functional impact and thus do not require intervention, since their evolution is relatively benign under medical therapy.[5,6]

In their study, Ramos et al. assessed the added value of integrating CMR myocardial perfusion imaging with anatomical assessment by CCTA in a population with suspected CAD referred for invasive coronary angiography.

As might be expected, the integrated protocol of anatomical and functional assessment by CCTA and CMR perfusion imaging, respectively, showed the best performance in identifying significant CAD. The question is in what cases such a protocol is justified, given the good performance of the exams separately, with an area under the receiver operating characteristic curve of >0.8, even for CCTA alone. The prevalence of CAD in this study was relatively high (44%), as was the proportion of patients with typical chest pain (25%) and diabetes (39%), considering that the risk profile of most patients undergoing CCTA is low to intermediate and they are referred to exclude the disease. This higher prevalence may explain the lower specificity (61%) and positive predictive value (67%) of CCTA in this study, giving more scope for improvement using the integrated protocol. The modest performance of CCTA may also be due to the inclusion

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of patients with significant coronary calcification; calcium score was >400 Agatston units in 45% and >1000 in 19%, and such high levels reduce the diagnostic accuracy of the exam.

Current thinking is that selection of the best exam to assess suspected CAD should take into consideration the pre-test probability of disease.[7,8] When the probability is high, it makes more sense to opt for a functional exam, since the physician's most important question is whether the patient should be kept under preventive medication only or whether coronary angiography should be performed with a view to revascularization. In patients with intermediate to low probability, on the other hand, the aim is to exclude the disease with reasonable certainty, in which case the exam of choice will be CCTA, due to its high negative predictive value. Another advantage of CCTA in the lower ranges of disease probability is its ability to identify non-obstructive CAD, which is not detected by other non-invasive methods that document ischemia.[9] Identification of a high coronary atherosclerotic burden can have prognostic impact even in the absence of obstructive disease, and may thus be a potential target for more aggressive primary prevention measures.[10,11]

Two more strengths of Ramos et al.'s study deserve mention: the emphasis on events during follow-up, and the radiation dose associated with the CCTA protocol. With regard to the former, the inclusion of a clinical follow-up enhances the analysis by allowing evaluation of the performance of the different protocols in terms of revascularization rates during follow-up, to a certain extent validating their prognostic value, which would be difficult to determine for major cardiac events, given the small sample size. Concerning radiation dose, the authors report a mean dose of 5.5 mSv, which is impressively low for a 64-slice scanner, nowadays considered the minimum for CCTA.[12] This figure compares favorably with results in the literature for more recent machines,[13] and is particularly important in this population since a second exam using ionizing radiation was included in the protocol to enable comparison with invasive coronary angiography.

In view of the obvious limitations to sequential access to these exams, the ideal solution would be to obtain anatomical and functional information in the same exam. In the short term this is more likely to become a reality with CCTA than with CMR, since the latter's performance for coronary angiography is still modest due to limited spatial resolution and lengthy acquisition times. Various lines of investigation are being followed for functional assessment by CCTA, particularly CT perfusion imaging with 320-slice[14] and dual-source[15] systems, and FFR measurement by CCTA,[16,17] although both are still at the research stage.

Finally, another advantage of these techniques is that they can perform coronary, extracoronary (such as left ventricular function and myocardial or pericardial disease) and extracardiac (including lungs and mediastinum) assessment in a single exam, increasing their diagnostic performance and making them a veritable 'one-stop shop' for patients with chest pain.

Conflict of interest

The author has no conflict of interest to declare.

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