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Imaging Coronary Artery Disease: A Cardiologist's Perspective

Authors:

Michael J. Zellweger, Peter T. Buser

Title: Department of Cardiology, University Hospital Basel

Email: MZELLWEGER@UHBS.CH, BUSERP@UHBS.CH

Reference are Available at EDITORIAL@IMAGINGMANAGEMENT.ORG

Cardiovascular disease is the leading cause of mortality in the Western world. Even though it is widely known that primary prevention of coronary artery disease (CAD) is the most important way to get this disease under control, everybody knows that it is also the most difficult to achieve. Reliable and cost-effective evaluation and therapy of CAD is, therefore, the major concern of cardiologists, especially as the incidence of CAD is still increasing. This is due to ageing of the population and the diabetes epidemic.

First Approach

What is the first approach with a potential CAD patient? A very important concept in cardiology is the pre-test probability of CAD in an individual patient. Patient age, gender and symptoms allow clinicians to estimate the pretest probability of coronary disease (1) (figure 1). Patients with a low probability of CAD do not need further testing, whereas patients with a high probability of CAD generally can be directly referred for invasive coronary angiography and, potentially, intervention. Patients with an intermediate probability of CAD benefit from non-invasive assessment and risk stratification. If the patient is able to perform a sufficient treadmill or ergometry test this is still an effective and easy first approach to evaluate CAD. However, cardiac imaging techniques (nuclear imaging, stress echocardiography, cardiac magnetic resonance imaging [CMR]) provide higher sensitivity and specificity than stress testing without imaging.

Furthermore, pharmacologic stress can be used in cardiac imaging, if patients are not able to perform physical stress tests. On the other hand, cardiac imaging techniques are more complex and expensive than ergometry or treadmill testing first with respect to acquisition and second with respect to handling. Since we expect to encounter a higher incidence of CAD over the next few decades, cardiac imaging modalities will become even more important in daily cardiology practice as non-invasive means of diagnosing or ruling out disease. The latter is also essential if cost-effectiveness is considered.

Imaging Techniques

For a long time, nuclear imaging and stress echocardiography were the only available imaging techniques for CAD evaluation. For nuclear imaging especially, there is extensive data supporting its reliable and cost-effective application in the assessment of CAD (2). Normal myocardial perfusion SPECT (MPS) studies are usually associated with very low risk, and patient risk increases significantly as a function of MPS results (3). Over the last decade, several other imaging modalities have emerged for CAD evaluation. Stress dobutamine and stress perfusion CMR have been shown to be reliable, safe and accurate procedures for studying acute and chronic CAD patients.

CMR is quite an appealing technique because of:

• absent radiation;

• its high spatial resolution; and

• the possibility to assess cardiac anatomy/ pathology, as well as flow physiology/ pathophysiology (4).

There was also great enthusiasm about the possibility of visualizing coronary arteries by CMR. However, this is still quite challenging. Three-dimensional coronary magnetic resonance angiography has been shown to allow for the accurate detection of coronary artery disease of the proximal and middle segments. This noninvasive approach reliably identified (or ruled out) left main coronary artery or three-vessel disease (5). However, routine CMR evaluation of coronary arteries is still experimental.

Computed Tomography

With respect to noninvasive coronary angiography, CT techniques have been evaluated extensively. To make multislice CT a clinically useful tool for evaluation of patients with suspected or known CAD, complete visualisation of all clinically relevant segments of coronary arteries and a reliable quantification of coronary artery stenoses within these segments are mandatory. This is particularly true if revascularisation procedures such as coronary angioplasty or bypass surgery are to be planned on the basis of multi-slice CT findings. Several studies with relatively small numbers of selected patients reported a high sensitivity and specificity for the detection of significant obstructive coronary lesions (6,7).

In daily practice, multislice CT is of limited diagnostic value for the diagnosis of CAD in consecutive patients (8). Despite a clinically useful sensitivity for the overall diagnosis of significant CAD, specificity was low. Thus, relevant decisions regarding the need of and suitability for possible revascularisation procedures cannot be based on CT findings alone.

Furthermore, one has to bear in mind that there is radiation and contrast exposure in patients undergoing CT – without the possibility to perform interventions during the same examination. Therefore, it is very likely that invasive x-ray coronary angiography remains the gold standard for the identification of clinically significant coronary artery disease which can be followed by a therapeutic intervention (percutaneous coronary intervention [PCI]).

However, as technology of CT techniques progresses (64-slice and eventually 128-slice CT), one can speculate that CT angiography will improve also for daily practice. Furthermore, its negative predictive value is excellent. If a patient has a low calcium score, prognosis is excellent (9). This might be an appropriate method to exclude relevant CAD in selected patients.

Conclusion

Two general thoughts to conclude: at our hospital, cardiologists have a well-established and complementary collaboration with radiologists. We think that this adds to the quality of cardiac imaging techniques and their proliferation. Also, technical aspects of imaging methods have become extremely complex. Regarding these special requirements, radiologists guarantee state-of-the-art imaging technique. Reading and interpreting the examinations with the cardiologist adds therapeutic impact to clinical assessment of a particular patient.

Yet another important issue is the incorporation of Picture Archiving and Communication Systems (PACS) into daily conferences and meetings. If pictures and clips of the heart are easily available and demonstrated to support a rationale, this will help to understand heart disease in further detail. In addition, it will also add to the proliferation of these highly sophisticated cardiac imaging techniques.

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