Viewpoint

Coronary Tomography Angiography and a New View on How to Investigate Coronary Artery Disease — New English Guideline

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With technological development, the tools for investigating and treating patients with suspected coronary artery disease (CAD) has become more effective, but more complex. Initially, investigation of CAD was performed with stress test associated with electrocardiography and invasive coronary angiography (ICA) in cases of higher risk. Currently, alternative provocative ischemia tests include myocardial perfusion scintigraphy, stress echocardiography and stress magnetic resonance imaging, while coronary artery angiography has emerged as a less invasive alternative to ICA for evaluating the presence of atherosclerotic lesions leading to luminal reduction of coronary arteries. This wide range of diagnostic alternatives may make it difficult to select the best diagnostic method both from a clinical view and from a cost optimization view.

Even before the current economic crisis, several groups have been studying these cost and effectiveness aspects in order to maintaining a long-term sustainable health system. Among these groups, the National Institute for Health and Care Excellence (NICE), from the UK, has become one of the world's major references. This group routinely reviews any clinical evidence available and publishes recommendations that have proven clinical efficacy and cost-effectiveness for investigation and treatment in a variety of clinical settings. Since 1997, these recommendations have been incorporated into the English National Health Services (NHS), which uses them as part of the optimization of the resources available.

The NICE group updated, in November 2016, the recommendations for investigating stable chest pain potentially originating in the coronary artery,[1] presenting a new approach with great changes over the current recommendations of the Brazilian Society of Cardiology (BSC)[2] and the European Society of Cardiology (ESC),[3] as well as over the previous NICE recommendations of 2010. For these societies, patients with chest pain should be evaluated for the pre-test probability of CAD using the original Diamond-Forrester classification or the most current pre-test probability scores, such as the updated version of that classification. In general, these guidelines suggest that no additional examination is necessary for low pre-test

Keywords

Coronary Artery Disease/physiopathology; Coronary Angiography; Echocardiography, Stress; Chest Pain/diagnostic imaging; Coronary, Angiotomography.

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individuals (< 10 – 15%). Functional tests or tomography angiography of the coronary arteries are recommended for intermediate probability individuals, while patients with a high pre-test probability (> 85 – 90%) should be considered as having CAD and treated as such. The definition of the best complementary method in intermediate probability individuals is different in each recommendation, but provocative ischemia tests usually associated with imaging tests are recommended for individuals with intermediate to high probability (50-90%), while tomography angiography of the coronary arteries and stress test are considered more usual alternatives for individuals of intermediate to low probability (10 – 50%).

In the NICE updates of 2016, two major changes can be perceived as to the approach described above. First, it is no longer to calculate the pre-test probability. NICE now recommends that all patients with typical or atypical chest pain, as well as all patients with non-anginal chest pain who present abnormalities on the resting electrocardiography should undertake noninvasive investigation for CAD. Patients with non-anginal chest pain and normal resting electrocardiography should preferably be investigated for other causes of non-coronary chest pain. The second update is that tomography angiography of the coronary arteries is the method of choice for the initial investigation of all these patients, except for those with previous history of CAD (history of infarction, angioplasty or coronary artery bypass grafting). According to these new English guidelines, provocative imaging ischemia tests are second-line tests in the initial approach and should be used to evaluate individuals in whom tomography angiography of coronary arteries was inconclusive or in cases of history of CAD, as defined above.

Despite the controversy, both changes were based on a critical analysis of the currently available evidence. Firstly, the authors question the calibration of the models for calculating the pre-test probability, as demonstrated in recent studies.[4] Many of these scores overestimate the likelihood of disease. This makes many patients considered of high probability to be wrongly treated as having obstructive CAD. Also for this reason, even if the specificity of tomography angiography is not as high as that of the ischemia-provoking methods, its high negative predictive value is very useful to rule out the hypothesis of CAD in this population. On the other hand, due to the higher sensitivity of coronary artery tomography angiography compared to ischemia-provoking methods, there is a reduced probability of false negatives that may lead to underdiagnosis and under-treatment of patients with obstructive CAD.

In addition to this rationale about the sensitivity and specificity of diagnostic methods, one of the main reasons for structuring the English recommendations in this format was the cost-effectiveness of the proposed strategy. In a recent study, a cost-effectiveness analysis was performed by comparing the initial investigation with all imaging methods followed or not by ICA, as well as the initial investigation with coronary artery tomography angiography followed or not by each of the functional methods (echocardiography, scintigraphy and stress magnetic resonance imaging), followed by ICA if the anatomical and functional test was abnormal. The strategies that led to the greatest gain in quality of life and cost-effectiveness were those that started with tomography angiography and were followed by one of three stress methods, followed by ICA only if both were abnormal.[5] According to the English recommendation, using this new guideline would result in savings of at least £16,000,000 pounds due to its greater effectiveness. Although cost data in other countries are limited, a PROMISE study suggests that tomography angiography may have a favorable cost-effectiveness profile also in the United States.[6] Recent data also suggest that tomography angiography of the coronary arteries would be cost-effective in the Brazilian reality and should be incorporated into the Brazilian health system.[7]

In addition to all the evidence presented above, other arguments in favor of the English recommendations have been described in the literature. Ideally, a diagnostic method should influence clinical decision and treatment, and these clinical decisions should result in improved patient prognosis. Initial studies comparing tomography angiography with perfusion methods were limited to analyzing the accuracy of detecting obstructive CAD. More recent studies have shown that even in non-obstructive CAD patients, its presence and extent is clearly associated with prognosis.[8] Subsequently, pharmacological treatment with statins in this population with non-obstructive disease has been shown to be associated with better prognosis.[9] Finally, recent studies have shown that the tomography angiography approach leads not only to increased use of pharmacological therapy and increased number of coronary artery bypass grafting surgeries, but also to a 30% reduction in the incidence of acute myocardial infarction.[10]

However, like any innovative decision, changing the English guidelines will entail a number of challenges. English data suggest that the availability of centers performing tomography angiography of coronary arteries will have to increase by 700% to absorb the new demand.[11] In addition, the training of qualified physicians to do these tests, as well as the systematization of quality assurance training has been questioned even in the English reality. From an economic point of view, a potential idleness to be created in the use of functional methods should be considered, as the demand for these methods would decrease. The implementation of these new recommendations would not pose fewer challenges in other realities, such as the Brazilian one. However, the evidence compiled in the new English recommendations associated with the proposed potential cost reduction makes it urgent to critically analyze the potential advantages, disadvantages and main barriers to the future incorporation of this new strategy in the Brazilian reality.

Authors' contributions

Research creation and design: Bittencourt MS; Data analysis and interpretation: Bittencourt MS; Manuscript drafting: Bittencourt MS; Critical revision of the manuscript for important intellectual content: Bittencourt MS.

Potential Conflicts of Interest

There are no relevant conflicts of interest.

Sources of Funding

This study had no external funding sources.

Academic Association

This study is not associated with any graduate program.

References

1. Cooper A, Calvert N, Skinner J, Sawyer L, Sparrow K, Timmis A, et al. Chest pain of recent onset:assessment and diagnosis of recent onset chest pain or discofort of suspected cardiac origin. London: National Clinical Guideline Centre for Acute and Chronic Conditons; 2010. (NICE Clinical Guideline n.95) PMID: 22420013

2. Cesar LA, Ferreira JF, Armaganijan D, Gowdak LH, Mansur AP, Bodanese LC, et al, Sociedade Brasileira de Cardiologia. Guideline for stable coronary artery disease. *Arquivos brasileiros de cardiologia*. 2014;103(2 Suppl 2):1-56 doi: http://dx.doi.org/10.5935/abc.20145004

3. Task Force M, Montalescot G, Sechtem U, Achenbach S, Andreotti F, Arden C, Budaj A, et al. 2013 ESC guidelines on the management of stable coronary artery disease: the Task Force on the management of stable coronary artery disease of the European Society of Cardiology. Eur Heart J. 2013;34(38):2949-3003. doi: 10.1093/eurheartj/eht296

4. Bittencourt MS, Hulten E, Polonsky TS, Hoffman U, Nasir K, Abbara S, et al. European Society of Cardiology-Recommended Coronary Artery Disease Consortium Pretest Probability Scores More Accurately Predict Obstructive Coronary Disease and Cardiovascular Events Than the Diamond and Forrester Score: The Partners Registry. *Circulation*. 2016;134(3):201-11. doi: 10.1161/CIRCULATIONAHA.116.02396

5. Genders TS, Petersen SE, Pugliese F, Dastidar AG, Fleischmann KE, Nieman K, et al. The optimal imaging strategy for patients with stable chest pain: a cost-effectiveness analysis. Ann Intern Med.2015;162(7):474-84. doi:10.7326/M14-0027

6. Mark DB, Federspiel JJ, Cowper PA, Anstrom KJ, Hoffmann U, Patel MR, et al. Economic outcomes with anatomical versus functional diagnostic testing for coronary artery disease. *Ann Intern Med*. 2016;165(2):94-102. doi: 10.7326/M15-2639

7. Bertoldi EG, Stella SF, Rohde LE , Polanczyk CA. Long-term cost-effectiveness of diagnostic tests for assessing stable chest pain: modeled analysis of anatomical and functional strategies. *Clin Cardiol*. 2016;39(5):249-56. doi:10.1002/clc.22532

8. Bittencourt MS, Hulten E, Ghoshhajra B, O'Leary D, Christman MP, Montana P, et al. Prognostic value of nonobstructive and obstructive coronary artery disease detected by coronary computed tomography angiography to identify cardiovascular events. *Circ Cardiovasc Imaging*. 2014;7(2):282-91. Doi:0.1161/CIRCIMAGING.113.001047

9. Hulten E, Bittencourt MS, Singh A, O'Leary D, Christman MP, Osmani W, et al. Coronary artery disease detected by coronary computed tomographic angiography is associated with intensification of preventive medical therapy and lower low-density lipoprotein cholesterol. *Circ Cardiovasc Imaging*. 2014;7(4):629-38. Doi: 10.1161/CIRCIMAGING.115.004419

10. Bittencourt MS, Hulten EA, Murthy VL, Cheezum M, Rochitte CE, Di Carli MF,et al. Clinical outcomes after evaluation of stable chest pain by coronary computed tomographic angiography versus usual care: a meta-analysis. *Circ Cardiovasc Imaging*. 2016;9(4):e004419. Doi:10.1161/CIRCIMAGING.115.004419

11. Nicol EP, Padley S, Rodite G, Roobtom, C. The challenge of national CT coronary angiography (CTCA) provision in response to NICE CG95 update 2016. London: British Society of Cardiovascular Imaging; 2016.