



Mexico-city does not look like Beverly-Hills: A multimodality and cardiac imager perspective!

João V. Vitola, MD, PhD, MASNC,^a and Rodrigo Cerci, MD^a

^a QUANTA, Curitiba, Brazil

Received Jun 6, 2019; accepted Jun 7, 2019
doi:10.1007/s12350-019-01806-9

See related article, pp. 1617–1624

There are many reasons why Mexico-city does not look like Beverly-Hills and it has nothing to do with the excellent, colorful, spicy food south of the border! As cardiac imagers, this is the first thing that comes to our mind when we read the paper of Antonio-Villa et al¹ who investigated patients referred for myocardial perfusion imaging single-photon emission computed tomography (MPI-SPECT), at a reference center for nuclear cardiology in Mexico-city. They described an abnormality rate of 66.5%! A tremendous contrast compared to the 8.7% that has been described by investigators from Cedars Sinai in Los Angeles.² In addition, at Cedars, they observed a progressive decrease in the abnormality rate from the 41% it was in early 1990s. This decline was such that these authors suggest considerations of more cost-effective strategies for the initial work up of these low probability patients than MPI-SPECT. All of these bring us the opportunity to discuss relevant issues such as: (1) the current opportunities for multimodality and integration, (2) the always important concept of patient centered imaging and the relevance of pre-test probability estimates, (3) the recent advances in computed coronary angiography (CCTA), with its advantages to exclude coronary heart disease (CHD), to diagnose initial non-obstructive disease and to guide prevention^{3,4} and finally, (4) the persistent underutilization of MPI-SPECT

in low to mid-income countries (LMICs) where CHD mortality remains excessively high.

We are fortunate to practice medicine at a time when so many good options to evaluate CHD are available. Certainly, our patients can benefit greatly from these advancements! In recent years, CCTA technology has progressed to deliver better spatial and temporal resolution, higher quality images, and much lower radiation dose. All of these is contributing to the increasing clinical experience and to recognition that CCTA is a robust technique, specially to exclude CHD with great accuracy, benefiting intermediate to low probability patients with suspected CHD.⁵ Perhaps many of the patients described in the publication from the Cedars Sinai, at least those with suspected disease, could have benefitted from this technique. In addition, CCTA is useful to detect CHD and guide management,⁶ prevention in the case of initial non-obstructive disease or even revascularization if advanced high-risk obstructive disease is clearly identified (such as a “tight” left main). In the other hand MPI-SPECT is a fabulous, mature, technique to evaluate physiology, myocardial ischemia, can be done with exercise and is extremely useful for patients with known CHD or those who have a high probability of having CHD. This is exactly the kind of patients the authors from Mexico-city described. Observe in their publication that 40.3% of patients had a history of prior myocardial infarction, 38.6% were diabetics and 25.9% were still actively smoking. If anything, with such a high abnormality rate, their data reinforces that patients in Mexico most likely have limited access to nuclear cardiology, as in so many other LMICs, which will be discussed further.

THE OPPORTUNITY FOR MULTIMODALITY: THIS IS A PARADIGM CHANGE IN THE EVALUATION OF PATIENTS WITH SUSPECTED DISEASE

We currently have the wonderful opportunity to practice medicine in times of multimodality with excellent option to evaluate CHD. Unfortunately, availability

Reprint requests: João V. Vitola, MD, PhD, MASNC, QUANTA, Curitiba, Brazil; joaovitola@quantam.com.br

J Nucl Cardiol 2019;26:1625–9.

1071-3581/\$34.00

Copyright © 2019 American Society of Nuclear Cardiology.

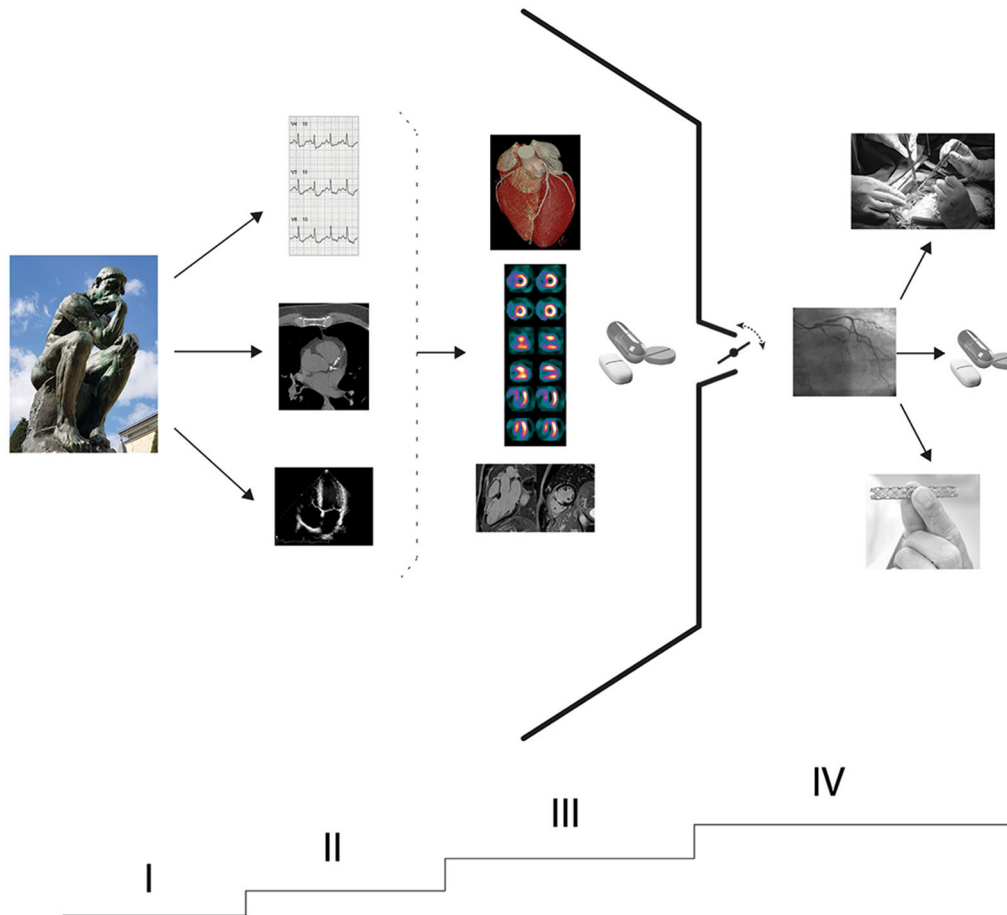


Figure 1. A stepwise approach to the investigation of CHD using clinical judgment and non-invasive imaging as a filter to invasive interventions. Concept of a stepwise strategy in the investigation of stable patients. It begins with a physician's best judgment raising diagnostic hypotheses (*I*). Observe the difference of more basic tests (*II*, ETT, ECHO and CACS) and more advanced non-invasive imaging (*III*, CCTA, MPI-SPECT and cMR). Importantly, non-invasive tests, whether basic or more advanced, should serve as “filters” for invasive testing/coronary angiography (*IV*), which should be used only if coronary revascularization is being considered. In addition, observe that patients defined as having CHD non-invasively should start medical therapy and aggressive prevention independent of the decision to revascularize. Adapted from Vitola⁹.

is extremely heterogeneous worldwide. Even when some advanced imaging techniques are available, not necessarily they can be used in routine practice, for several reasons related: to costs, reimbursement, regulations and/or just patterns of local practice and level of knowledge of professionals in that given country. This brings us to another important issue, which is the need to “choose wisely”, preventing over and under—utilization of a given technique. Evidence-based medicine should be practiced, as well as, patient centered imaging, doing what is appropriate, with the help, for example, of already published appropriateness use criteria.⁷ CCTA is becoming more widely available and if appropriately

used, to the right patient, it can be very helpful. The risk of applying CCTA as a first-line test in suspected CHD is to increase revascularization rates as demonstrated by the PROMISE trial, without in fact changing mortality.⁸ This is not desirable and contributes to increase health-care costs, which, of course, is important for any country but specially LMICs that have to deal with a high prevalence of disease, high-mortality rates and limited resources. But increasing revascularization rates is not CCTA's fault, which is accurately identifying patients with CHD, benefiting those who need to initiate medical treatment to reduce their long-term event rate. The SCOT-HEART trial 5-year follow-up data showed that

Table 1. Demographics of 44,589 patients submitted to MPI-SPECT from March 2010 to April 2019 at QUANTA in Curitiba, Brazil

Variables	N = 44589
Age, mean ± SD	62.15 ± 12.50
Female gender, n (%)	21587 (48.4)
Hypertension, n (%)	28248 (63.4)
Diabetes, n (%)	11301 (25.3)
Dyslipidemia, n (%)	23716 (53.2)
Family Hx of premature CAD, n (%)	8183 (18.4)
Current smoker, n (%)	4341 (9.7)
Known CAD, n (%)	9286 (20.8)
Angioplasty, n (%)	6633 (14.9)
Bypass, n (%)	2919 (6.5)
Previous MI, n (%)	4921 (11.0)
Symptoms	
Dyspnea, n (%)	12919 (29.0)
Atypical angina, n (%)	11434 (25.8)
Typical angina, n (%)	2801 (6.3)
MPI-SPECT result	
Abnormal, n (%)	13471 (30.2)
Ischemia, n (%)	10057 (22.6)
Fixed defect (scar), n (%)	1935 (4.3)
Mixed (ischemia + scar), n (%)	1429 (3.2)
Other abnormalities, n (%)	652 (1.5)
Normal, n (%)	30466 (68.3)
SSS above 13, n (%)	1873 (4.2)
Stress protocol	
Exercise, n (%)	29779 (66.9)
Pharmacological, n (%)	12109 (27.2)
Hybrid (exercise + pharma), n (%)	2633 (5.9)

SD, Standard deviation; Hx, history; CAD, coronary artery disease; MI, myocardial infarction; SSS, summed stress score

when appropriately used, CCTA can reduce non-fatal myocardial infarction, without increasing revascularization rates, compared to standard of care.⁶ One of the main differences between PROMISE and SCOT-HEART trials, beyond the population prevalence of CHD and follow-up (2 vs 5 years, respectively) was that in SCOT-HEART, 85% of patients had some form of functional data in both study arms (standard of care and CCTA). In fact, what is needed to prevent unnecessary revascularization is not to limit CCTA utilization but have it more integrated, including making use of all the robustness that nuclear cardiology can offer. In other words, we should offer patients a stepwise approach to the investigation of CHD, using “non-invasive filters” to prevent “inappropriate” invasive procedures⁹ (Figure 1) but never forgetting the benefit that CHD patients obtain from medical therapy.

Interestingly, the reality we are seeing in our patients at QUANTA in Curitiba - Brazil is somewhere in between the reality described in the papers from Mexico and from the United States, with an abnormality rate of 30.2% (Table 1). Observe that our patients have a similar age compared to the Mexicans (62 vs 63 years old) but we see more female patients (48.4% vs 35.8%), our prevalence of diabetes, although still high, is lower than the one observed in Mexico (25.3% vs 38.6%), we have less active smokers (9.7% vs 25.9%) and our rate of prior myocardial infarction is much lower (11.0% vs 40.3%). All of these explain the difference observed in MPI-SPECT abnormality rate (30.2% vs 66.6%). Interestingly, over the past several years, we are observing a progressive increase in the utilization of CCTA (Figure 2), driven mostly by the high negative predictive value of this technique to exclude CHD in patients with suspected, but intermediate to low probability of CAD. Many times, patients with mild perfusion deficits on MPI-SPECT have their anatomy known using CCTA instead of the old fashion invasive coronary angiography. Not infrequently we performed MPI-SPECT after CCTA, when a patient had CHD documented by CCTA, exactly to prevent patients with normal perfusion and function from undergoing unnecessary revascularization or any interventional procedure as a matter of fact. This way, as demonstrated in Figure 2, we have not seen an important drop of MPI-SPECT utilization despite the progressive growth of CCTA utilization. What we are progressively seeing are referring physicians becoming more familiarized with each technique and what they can offer in the multiple different clinical scenarios.

LOW UTILIZATION OF NUCLEAR CARDIOLOGY IN MANY COUNTRIES WHERE CHD MORTALITY REMAINS HIGH

It seems that NC is still underused where it is most needed! We have previously reported, in a paper from the International Atomic Energy Agency,¹⁰ the low or non-existent utilization of nuclear cardiology in many low to mid-income countries (LMICs), the so-called developing nations. In fact, in many of these LMICs, access to any form of non-invasive advanced imaging is very limited. Curiously, these are frequently the same countries where mortality rates are very high. This does not necessarily mean a cause and effect relationship, but could serve as a marker of income, lack of investments and access to healthcare and/or the choice of different strategies to investigate patients in that given country. Unfortunately, in some countries, low utilization of a technique such as MPI-SPECT, that could serve as a “filter” to invasive procedures (Figure 1), results in

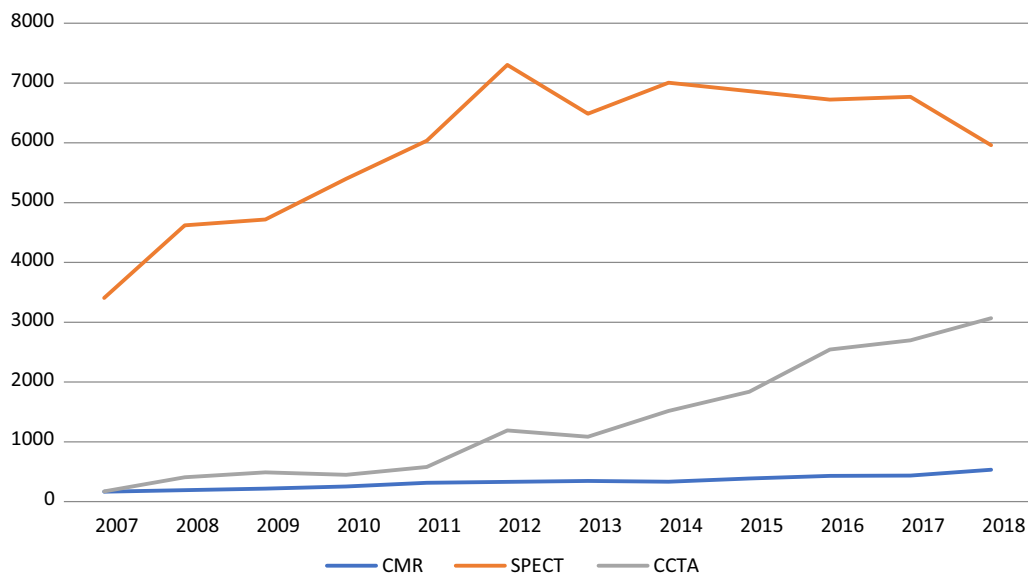


Figure 2. Trends in non-invasive advanced cardiovascular imaging utilization per year in Curitiba/Brazil. Observe the progressive increase in utilization of SPECT from 2007 to 2012 with a plateau and slight decrease for the following 6 years. In contrast, the use of CCTA has progressively increased. We have not observed significant changes in the use of cMR in our region.

high rates of invasive coronary angiography and revascularizations.¹¹

The work from Antonio-Villa et al¹ from Mexico raises a very important issue. Nuclear cardiology still has a tremendous role outside of high-income countries, such as the United States. Countries where population is faced with high-mortality rate due to CHD has no or limited access to such an important technique. In these places, the great diagnostic and prognostic value of NC, combined with the ability to serve as a “filter” to invasive procedures is clearly underused.

We have wonderful opportunities for integration of multimodality, especially CCTA and MPI-SPECT. In addition, certainly Mexico-City does not look like Beverly-Hills, and the comparison of the data from three different referral institutions in three different countries, clearly demonstrates the importance of patient centered imaging and the relevance of pre-test probability estimates when choosing the best investigation strategy. Nuclear cardiology is a technique still underutilized in many LMICs where CHD mortality remains high. The growth of CCTA opens a new opportunity for nuclear cardiology for functional assessment of CCTA-detected obstructive disease, to continue guiding management in CHD, and preventing unnecessary interventions.

Disclosure

João V. Vitola and Rodrigo Cerci declare that they have no conflicts of interest beyond working as cardiac imagers.

References

1. Antonio-Villa NE, Espinola-Zavaleta N, Carvajal-Juarez I, Flores-Garcia AN, Alexanderson-Rosas E. Comorbid conditions in individuals assessed by SPECT: Study of a reference cardiology center in Mexico City. *J Nucl Cardiol* 2019. <https://doi.org/10.1007/s12350-019-01737-5>.
2. Rozanski A, Gransar H, Hayes SW, Min J, Friedman JD, Thomson LE, et al. Temporal trends in the frequency of inducible myocardial ischemia during cardiac stress testing: 1991 to 2009. *J Am Coll Cardiol* 2013;61:1054-65.
3. Min JK, Dunning A, Lin FY, Achenbach S, Al-Mallah M, Budoff MJ, et al. Age- and sex-related differences in all-cause mortality risk based on coronary computed tomography angiography findings: Results from the International Multicenter CONFIRM (Coronary CT Angiography Evaluation for Clinical Outcomes: An International Multicenter Registry) of 23,854 patients without known coronary artery disease. *J Am Coll Cardiol* 2011;58:849-60.
4. 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;7:629-38.
5. Members Task Force, Montalescot G, Sechtem U, Achenbach S, Andreotti F, Arden C, et al. 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;2013(34):2949-3003.
6. SCOT-HEART Investigators. Coronary CT angiography and 5-year risk of myocardial infarction. *N Engl J Med* 2018;379:924-33.
 7. Hendel RC, Berman DS, Di Carli MF, Heidenreich PA, Henkin RE, Pellikka PA, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 appropriate use criteria for cardiac radionuclide imaging: A report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the American Society of Nuclear Cardiology, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the Society of Cardiovascular Computed Tomography, the Society for Cardiovascular Magnetic Resonance, and the Society of Nuclear Medicine. *J Am Coll Cardiol* 2009;53:2201-29.
 8. Douglas PS, Hoffmann U, Patel MR, Mark DB, Al-Khalidi HR, Cavanaugh B, et al. Outcomes of anatomical versus functional testing for coronary artery disease. *N Engl J Med* 2015;372:1291-300.
 9. Vitola JV. A need to reduce premature CV mortality in the developing world: How could appropriate use of non-invasive imaging help? *J Nucl Cardiol* 2019;26:975-85.
 10. Vitola JV, Shaw LJ, Allam AH, Orellana P, Peix A, Ellmann A, et al. Assessing the need for nuclear cardiology and other advanced cardiac imaging modalities in the developing world. *J Nucl Cardiol* 2009;16:956-61.
 11. Cerci JJ, Trindade E, Preto D, Cerci RJ, Lemos PA, Cesar LA, et al. Investigation route of the coronary patient in the public health system in Curitiba, Sao Paulo and in InCor—IMPACT study. *Arquivos Brasileiros De Cardiologia* 2014;103:192-200.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.