



## EDITORIAL COMMENT

## Coronary physiology in clinical practice in Portugal: A problem of technology or a question of attitude?



### Fisiologia coronária na nossa prática: um problema de tecnologia ou uma questão de atitude?

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Anatomical assessment of the severity of coronary stenosis by angiography has most often been used to guide the need for coronary revascularization. However, following the evidence of three landmark studies (DEFER,<sup>1</sup> FAME 1<sup>2</sup> and FAME 2<sup>3</sup>), fractional flow reserve (FFR) has become the gold standard invasive diagnostic test to guide revascularization of intermediate coronary lesions, especially in the presence of multivessel coronary artery disease.

FFR-guided revascularization has been extensively validated in large clinical outcomes studies,<sup>1-3</sup> and has proved to be more cost-effective than angiography-based revascularization.<sup>4</sup> In the current European revascularization guidelines, it has a class I recommendation, level of evidence A.<sup>5</sup> However, despite all the evidence and recommendations, invasive physiological assessment to guide coronary intervention continues to be underused in Portuguese cath labs. In the article by Raposo et al. published in this issue of the *Journal*,<sup>6</sup> the overall adoption of physiology-guided revascularization in a large population (40 821) in two large-volume centers who underwent coronary angiography over a ten-year period (2007-2018) was very low (0.6-6%). This prompts reflection on the main barriers that hinder actions in line with the recommendations. Other authors have identified factors that affect the likelihood that cli-

nicians will follow clinical practice guidelines, particularly their knowledge, attitude and behavior.<sup>7</sup> For each of these factors, there may be barriers to adherence to the guidelines.

Regarding knowledge, Raposo et al.'s paper<sup>6</sup> demonstrates a relationship between rates of invasive physiology assessment over time and relevant landmark studies. Adoption increased significantly from 0.9% to 4.0% after the publication of FAME 1, and there was a significant 1.67-fold increase in adoption rates in the setting of chronic coronary syndromes in the period following the publication of the 2014 European myocardial revascularization guidelines and long-term (two-year) results of the FAME 2 trial. However, although these publications influenced the adoption of invasive physiological assessment, their impact was small and did not result in widespread use of FFR. Thus, other factors have been suggested as having limited the uptake of invasive physiology in clinical practice: reimbursement, the technical properties of pressure sensor-tipped guidewires that lead to drift and increase the complexity of the procedure, and the need for hyperemic drugs that have the disadvantages of cost, time and side effects.<sup>8</sup> For the latter reason, new non-hyperemic physiological indices have been developed, of which the instantaneous wave-free ratio (iFR) has been the most studied in randomized controlled trials (DEFINE-FLAIR<sup>9</sup> and iFR-SWEDEHEART<sup>10</sup>) and has been shown to be non-inferior to FFR guidance in terms of clinical outcomes.

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Additional evidence suggests that other diastolic pressure indices are numerically equivalent to iFR. Theoretically, due to the elimination of vasodilator drugs, iFR entails lower procedure time, drug side effects and costs.<sup>11</sup> But these theoretical advantages did not translate into an increase in the use of invasive physiological assessment in Raposo et al.'s study.<sup>6</sup> Publication of iFR trials had no influence on coronary physiology adoption rates, except for a higher proportion of iFR use. The use of non-hyperemic physiological indices is feasible, cost-effective and patient-friendly. They are progressively replacing FFR, but this is not reflected in an overall increase in the use of physiology-guided coronary revascularization.

All the new wire-based indices share the same limitations, such as susceptibility to pressure-sensor drift and poor guidewire handling. Advances in technology have sought to respond to the limitations of invasive assessment of coronary physiology, and new indices have been developed that may replace the traditional pressure wires and adenosine to assess FFR. These include image-derived FFR, such as noninvasive computed tomography imaging-derived FFR and angiography-derived FFR (quantitative flow ratio, vessel FFR or FFR-angio) that can be performed while the patient is in the cath lab.<sup>11</sup> Nevertheless, I believe that these remarkable technologies are not sufficient to ensure the widespread use of physiology-guided revascularization, because the greatest problem is not so much of knowledge or external barriers that constrain behavior, it is a problem of attitude. The barriers are not cognitive; they are in fact affective. Certainly, it is not the case that interventional cardiologists are unfamiliar with the evidence supporting the role of FFR or with the most up-to-date practice guidelines. They may not agree with the recommendations, may have low outcome expectancy, lack motivation, or suffer from inertia due to their previous practices. The greatest barrier to the use of coronary physiology is still physicians' perception that it is not needed, as some remain wedded to 'eyeball' estimation of coronary stenosis on the angiogram for therapeutic decision-making in intermediate coronary lesions. However, visual assessment of lesion severity does not always reflect the hemodynamics of coronary artery stenosis.

Less invasive technologies to assess coronary physiology may help to change the scenario in the near future, but the main contribution must be from a change in attitude, which will come more easily to younger generations. To change the mindset of operators from anatomy to physiology, we need to change attitudes.

## Conflicts of interest

The author has no conflicts of interest to declare.

## References

1. Pijls NH, van Schaardenburgh P, Manoharan G, et al. Percutaneous coronary intervention of functionally nonsignificant stenosis: 5-year follow-up of the DEFER study. *J Am Coll Cardiol*. 2007;49:2105–11.
2. Tonino PA, De Bruyne B, Pijls NH, et al. FAME Study Investigators. Fractional flow reserve versus angiography for guiding percutaneous coronary intervention. *N Engl J Med*. 2009;360:213–24.
3. De Bruyne B, Pijls NH, Kalesan B, et al. FAME 2 Trial Investigators. Fractional flow reserve-guided PCI versus medical therapy in stable coronary disease. *N Engl J Med*. 2012;367:991–1001.
4. Fearon WF, Bornschein B, Tonino PA, et al. Fractional Flow Reserve Versus Angiography for Multivessel Evaluation (FAME) Study Investigators. Economic evaluation of fractional flow reserve-guided percutaneous coronary intervention in patients with multivessel disease. *Circulation*. 2010;122:2545–50.
5. Neumann FJ, Sousa-Uva M, Ahlsson A, et al., ESC Scientific Document Group. 2018 ESC/EACTS guidelines on myocardial revascularization. *Eur Heart J*. 2019;40:87–165.
6. Raposo L, Gonçalves M, Roque D, et al. Adoption and patterns of use of invasive physiological assessment of coronary artery disease in a large cohort of 40 821 real-world procedures over a 12-year period. *Rev Port Cardiol*. 2021, <http://dx.doi.org/10.1016/j.repc.2021.01.010>.
7. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. 1999;282:1458–65.
8. Ntalianis A, Trana C, Muller O, et al. Effective radiation dose, time, and contrast medium to measure fractional flow reserve. *JACC Cardiovasc Interv*. 2010;3:821–7.
9. Davies JE, Sen S, Dehbi HM, et al. Use of the instantaneous wave-free ratio or fractional flow reserve in PCI. *N Engl J Med*. 2017;376:1824–34.
10. Götberg M, Christiansen EH, Gudmundsdottir IJ, et al. iFR-SWEDEHEART Investigators. Instantaneous wave-free ratio versus fractional flow reserve to guide PCI. *N Engl J Med*. 2017;376:1813–23.
11. De Maria GL, Garcia-Garcia HM, Scarsini R, et al. Novel indices of coronary physiology: do we need alternatives to fractional flow reserve? *Circ Cardiovasc Interv*. 2020;13:e008487.