



## EDITORIAL COMMENT

# Heart rate reduction for cardiac computed tomography: A necessary evil?☆



## Redução da frequência cardíaca para a tomografia computadorizada cardíaca: um mal necessário?

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Cardiac computed tomography (CT) angiography (CCTA) is established as an essential technique in the assessment of coronary artery disease. Although the latter is its primary indication, the range of application has progressively extended to other areas of cardiology, and it is now an important tool for the assessment of structural heart disease and the planning of procedures in arrhythmology and interventional cardiology,<sup>1</sup> particularly transcatheter aortic valve implantation and atrial fibrillation ablation.

However, the main challenge for CCTA remains assessment of the coronary arteries, due to their small size and their movement, which create difficulties for the equipment's hardware and software. Technological advances in recent years have led to improvements in spatial and temporal resolution and craniocaudal coverage, with reductions in contrast and radiation dose without compromising diagnostic accuracy, making these exams increasingly reliable.<sup>2</sup>

It is against this background that the article by Rosa et al.,<sup>3</sup> published in this issue of the *Journal*, addresses

a question of practical importance in the acquisition of CCTA studies, namely the efficacy and particularly the safety of beta-blockers for patient preparation before CCTA. The authors assessed a protocol for reducing heart rate (HR) as bailout for failed oral metoprolol regimens in patients undergoing non-invasive coronary angiography on a conventional 64-slice CT scanner. The study analyzed 947 exams, in 14% of which supplementary esmolol was required due to failure to achieve HR of <65 bpm following administration of oral metoprolol alone.

The strong points of the study are (1) that it presents a protocol that could be adopted by other institutions beginning to use CCTA, particularly with a conventional 64-slice machine; (2) it showed that oral metoprolol (50-100 mg 1 h before the exam) resulted in HR of <65 bpm in 86% of cases; and (3) it demonstrated that supplementary esmolol increased this figure to 95% with few adverse effects (the combined safety endpoint of symptomatic hypotension or symptomatic bradycardia was only observed in 1.5% of cases).

The study by Rosa et al. focuses on fundamental questions: what is the rationale for the use of beta-blockers to reduce HR? In what circumstances should we persist in efforts to optimize this aspect of patient preparation? The need to reduce HR before performing CCTA depends on the individual patient's characteristics (including age, pretest probability, degree of calcification, body mass index, and

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presence of arrhythmias), which can affect the quality of the exam,<sup>4</sup> and the type of CT scanner used.<sup>5,6</sup> The present article was based on studies with a 64-slice scanner, which is currently considered the minimum for such exams,<sup>7</sup> having been introduced into clinical practice in 2004. Such machines are heavily dependent on low HR during acquisition, but technological advances have made this less important and low HR is almost irrelevant with more recent equipment, especially with the high temporal resolution of dual-source scanners.<sup>5,8</sup>

At the same time, although feasible and safe, beta-blocker therapy before CCTA is always a limiting factor and should be seen as a necessary evil, not only clinically (due to possible contraindications and/or adverse effects such as hypotension or symptomatic bradycardia) but also logistically, due to the need to keep the patient under surveillance for longer after the exam or even before it, in the case of oral beta-blockade as in the present work, requiring the use of more human and other resources, such as recovery rooms. An illustration of these limitations is the fact that in Rosa et al.'s study the mean time between administration of oral metoprolol and of intravenous esmolol was 82 min, and although the combined safety endpoint was only observed in 1.5% of cases, systolic blood pressure fell to <90 mmHg in 8% of cases.

These issues have been taken on board by the medical equipment industry, along with other unmet needs such as reducing contrast and radiation doses, and the latest generations of cardiac CT scanners have been designed to address them. For example, the mean radiation dose reported in the study by Rosa et al. with a 64-slice scanner was 9.8 mSv, significantly higher than that reported in a recently published Portuguese multicenter registry (5.4 mSv) using a first-generation dual-source machine.<sup>9</sup> It is thus to be hoped that such problems will soon be a thing of the past, as within a few years new-generation dual-source 2×192-slice scanners and single-source 320-slice devices will progressively replace the current 64-slice machines.

## Conflicts of interest

The author has no conflicts of interest to declare.

## References

1. de Araujo Goncalves P, Campos CA, Serruys PW, et al. Computed tomography angiography for the interventional cardiologist. *Eur Heart J Cardiovasc Imaging*. 2014;15:842–54.
2. Deseive S, Chen MY, Korosoglou G, et al. Prospective randomized trial on radiation dose estimates of CT angiography applying iterative image reconstruction: the PROTECTION V study. *JACC Cardiovasc Imaging*. 2015;8:888–96.
3. Rosa SA, Ramos R, Marques H, et al. Bailout intravenous esmolol for heart rate control in cardiac computed tomography angiography. *Rev Port Cardiol*. 2016;35:673–8.
4. Vanhecke TE, Madder RD, Weber JE, et al. Development and validation of a predictive screening tool for uninterpretable coronary CT angiography results. *Circ Cardiovasc Imaging*. 2011;4:490–7.
5. Alkadhi H, Stolzmann P, Desbiolles L, et al. Low-dose, 128-slice, dual-source CT coronary angiography: accuracy and radiation dose of the high-pitch and the step-and-shoot mode. *Heart*. 2010;96:933–8.
6. de Graaf FR, Schuijf JD, van Velzen JE, et al. Diagnostic accuracy of 320-row multidetector computed tomography coronary angiography in the non-invasive evaluation of significant coronary artery disease. *Eur Heart J*. 2010;31:1908–15.
7. Abbara S, Arbab-Zadeh A, Callister TQ, et al. SCCT guidelines for performance of coronary computed tomographic angiography: a report of the Society of Cardiovascular Computed Tomography Guidelines Committee. *J Cardiovasc Comput Tomogr*. 2009;3:190–204.
8. Gordic S, Husarik DB, Desbiolles L, et al. High-pitch coronary CT angiography with third generation dual-source CT: limits of heart rate. *Int J Cardiovasc Imaging*. 2014;30:1173–9.
9. de Araujo Goncalves P, Jeronimo Sousa P, Cale R, et al. Effective radiation dose of three diagnostic tests in cardiology: single photon emission computed tomography, invasive coronary angiography and cardiac computed tomography angiography. *Rev Port Cardiol*. 2013;32:981–6.