Rev Port Cardiol. 2018;37(11):885–887

Portuguese Society of CARDIOLOGY

Revista Portuguesa de
Cardiologia
Portuguese Journal of Cardiology
www.revportcardiol.org

EDITORIAL COMMENT

Cardiac computed tomography for atrial fibrillation ablation – a one-stop shop?☆

TC cardíaca na ablação da fibrilhação auricular – *one-stop-shop*?

Ana G. Almeida

Hospital Universitário de Santa Maria, Faculdade de Medicina da Universidade de Lisboa, Lisboa, Portugal

Available online 28 November 2018

Cardiac imaging has brought about spectacular innovations in the diagnosis, treatment, monitoring and outcome of cardiovascular disease, and the different imaging modalities constitute a set of tools that are crucial to clinical practice, research and education. The quality and accuracy of the information they provide have improved enormously in the last ten years, in parallel with other impressive technological advances in health care.

Cardiac computed tomography (CCT) has been at the forefront of clinical practice since the introduction in 2004 of 64-slice scanners, which enabled highly accurate and reproducible assessment of coronary lesions. Other clinical applications have also emerged, including in electrophysiology for planning of procedures such as ablation and left atrial appendage closure for the treatment of atrial fibrillation (AF), which are now well-established therapies.[1] When planning ablation, CCT provides high-resolution anatomical images of the left atrium and pulmonary veins that can be integrated during the procedure, increasing its accuracy and shortening its duration. Importantly, it can also exclude the presence of thrombi in the left atrium and atrial appendage, an essential step in the ablation procedure and one that has traditionally been performed using transesophageal echocardiography (TEE).

However, CCT has its disadvantages, notably the need for exposure to ionizing radiation and for administration of iodinated contrast. While the latter is relatively easy to manage, by appropriate selection and preparation of patients, radiation exposure is unavoidable and carries potentially serious health risks. The biological effects of ionizing radiation are related to the cumulative effective dose, and its stochastic effects may include the development of cancer, although such effects are assumed to come into play only following acute radiation exposure at high doses (figures of >100 mSv have been suggested).[2] The risks associated with low doses, such as those used for diagnostic exams, are less well understood; it has been suggested that there is a threshold dose below which there is no harmful effect, or even that low levels of radiation are protective against the risk of cancer. However, given the lack of convincing evidence from epidemiological studies, it is generally accepted that exposure to any level of radiation carries risks, and that therefore the ''as low as reasonably achievable,'' or ALARA, principle should be applied, by which the use of imaging studies should

DOI of original article: https://doi.org/10.1016/j.repce.2018.03.018

☆ Please cite this article as: Almeida AG. TC cardíaca na ablação da fibrilhação auricular – *one-stop-shop*? Rev Port Cardiol. 2018;37:885–887.

E-mail addresses: anagalmeida@gmail.com, amalmeida@medicina.ulisboa.pt

be rational and reasonable in order to minimize radiation exposure as far as possible.[3]

Recent technological developments, as well as improved diagnostic ability, have also led to significant changes in clinical attitudes and in diagnostic guidelines, for example in the use of CCT for assessment of stable coronary artery disease.[4]

The technological advances that have resulted in improved image quality and lower radiation doses include current modulation, prospective acquisition and iterative image reconstruction, together with developments in hardware including dual-source scanners with high pitch and acquisition volume, enabling image acquisition in a single cardiac cycle. This is particularly advantageous in patients with arrhythmias, including AF, which is the most frequent arrhythmia in the general population, especially in older individuals.

Clinical validation of new technological developments is the subject of considerable study, since the speed which such developments become available implies the need for equal rapidity in validating them for clinical application.

It is against this background that a study by Marques et al.[5] is published in this issue of the *Journal*, based on a prospective registry, from which 270 patients were selected in whom CCT was performed prior to AF ablation to detect left atrial thrombi, aiming to assess the impact of CCT protocol optimization and technological advances on contrast and radiation doses and on image quality. The study is a good illustration of the difficulties associated with rapid technological advances in CCT with which the authors have had to deal.

The study population were divided into three chronologically ordered groups representing different stages of technological development. The first two groups underwent exams using a first-generation dual-source 64-slice scanner. A conventional retrospective protocol was used in Group 1, with tube current modulation and peak voltage selected according to body mass index, while in Group 2 the protocol was optimized, using a prospective protocol in patients with regular or arrhythmic heart rate and little R-R variability, and reducing peak voltage and contrast volume. Image quality was similar in these two groups but radiation dose decreased substantially, from 5.6 mSv to 1.3 mSv. Group 3, the most recent, was studied with a third-generation dual-source 192-slice scanner using iterative image reconstruction. As well as enabling images to be acquired in a single heartbeat, which has significant advantages in cases of arrhythmia, this protocol also led to a marked reduction in radiation dose, to a median of 0.6 mSv, as well as to a significantly smaller contrast volume. Image quality in Group 3 was also better than in the previous two groups according to both subjective (visual) and objective (quantitative) assessments.

The choice of quantitative parameters for the objective assessment was interesting: signal-to-noise and contrast-to-noise ratios and density homogeneity, the latter of which was used in this case to distinguish blood flow from thrombus, but can potentially be used for other applications.

The diagnostic accuracy of CCT for the exclusion of thrombi, amply demonstrated in other studies, which report negative predictive values of over 99% validated by TEE,[6–8] was not tested in this study, in which the prevalence of thrombi (in a low-risk and appropriately anticoagulated population) was extremely low. Even so, the few cases in which there were doubts concerning the presence of thrombus underwent a second scan without additional contrast administration and were confirmed by TEE. The need for a second scan was less frequent in the group assessed using the third-generation scanner.

The optimized protocols were shown to give superior results to those in other published studies in terms of radiation and contrast dose, without sacrificing diagnostic quality.

This study clearly demonstrates the value of innovative advances in technology and increasing expertise in CCT, not only as applied to pre-AF ablation assessment, but with obvious potential for the study of other cardiovascular conditions.

These developments, which will undoubtedly become standard practice in the near future, open up novel possibilities for this imaging modality, due to the quality and reliability of its results, together with marked reductions in radiation doses. Further studies will be needed to establish the actual cost/benefit ratio of CCT, balancing its high and still improving diagnostic quality against patient safety concerns and cost, but we can predict that upcoming technological developments, although they will pose new questions and challenges, are also bound to present both new diagnostic possibilities and reductions in exposure to risk.

Conflicts of interest

The author has no conflicts of interest to declare.

References

1. Liddy S, Buckley U, Kok HK, et al. Applications of cardiac computed tomography in electrophysiology intervention. Eur Heart J Cardiovasc Imaging. 2018;19:253–61.
2. Kalra MK, Sodickson AD, Mayo-Smith WW. CT radiation: key concepts for gentle and wise use. Radiographics. 2015;35:1706–21.
3. Einstein AJ. Radiation dose reduction in coronary CT angiography: time to buckle down. JACC Cardiovasc Imaging. 2015;8:897–9.
4. National Institute for Health and Clinical Excellence: Guidance. Chest pain of recent onset: assessment and diagnosis. Clinical guideline [CG95]. Published date: March 2010, last updated: November 2016. https://www.nice.org.uk/guidance/cg95.
5. Marques H, Araújo Gonçalves P, Ferreira AM, et al. Cardiac computed tomography prior to atrial fibrillation ablation: effects of technological advances and protocol optimization. Rev Port Cardiol. 2018;37:873–83.

6. Romero J, Husain SA, Kelesidis I, et al. Detection of left atrial appendage thrombus by cardiac computed tomography in patients with atrial fibrillation: a meta-analysis. Circ Cardiovasc Imaging. 2013;6:185–94.
7. Lazoura O, Ismail TF, Pavitt C, et al. A low-dose, dual-phase cardiovascular CT protocol to assess left atrial appendage anatomy and exclude thrombus prior to left atrial intervention. Int J Cardiovasc Imaging. 2016;32:347–54.
8. Wang L, Kadiyala M, Koss E, et al. CTA detection of left atrial stasis and thrombus in patients with atrial fibrillation. Pacing Clin Electrophysiol. 2016;39:1388–93.