Revista Portuguesa de Cardiologia 43 (2024) 375–376

Portuguese Society of CARDIOLOGY

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

EDITORIAL COMMENT

Minimizing ionizing radiation exposure in interventional cardiology: Still a long way to go

Minimização da exposição a radiação ionizante na Cardiologia de Intervenção: um longo caminho pela frente

Daniel A. Gomes*, **Sérgio Madeira**, **Henrique Mesquita Gabriel**

Hospital de Santa Cruz, Centro Hospitalar de Lisboa Ocidental, Lisboa, Portugal

Available online 3 February 2024

The benefits of invasive coronary angiography and intervention (PCI) are unquestionable in the diagnosis and treatment of coronary artery disease (CAD). Nevertheless, it depends on the use of ionizing radiation, which can adversely impact both the patients and healthcare providers.[1,2] The harmful effects of radiation in human beings can either be deterministic (direct effects in tissues characterized by a predictable (i.e., above a certain threshold) dose-related increase in severity, such as ocular lens defects or skin burns) or stochastic (as cancer incidence which occurs with a longer latency and a probability that increases with dose if exposure, without any particular threshold).[2]

Interventional cardiologists are among the health professionals exposed to the highest cumulative dose of radiation, and this issue is even more significant with increased exposure, such as in complex coronary intervention (e.g., chronic total occlusion; CTO).[3] Accordingly, in recent years, radiation doses have become a topic of significant interest and efforts have been made to reduce both patient and medical staff exposure during procedures.[2,3] Nevertheless, a recent survey among Portuguese Association of Interventional Cardiology members revealed that as many as two-thirds were unaware of the radiation exposure category, and surprisingly only 60% reported systematically using a dosimeter.[4]

It is true that in the last 15 years, there has been a significant drop in radiation doses in interventional cardiology procedures, with kerma area product (KAP) values decreasing by as much as 10% for PCI.[5,6] Further technological improvements, with new X-ray systems, as well as increased awareness and optimized imaging protocols are expected to maintain this trend. Also, with regard to exposure to ionizing radiation, physicians should follow the *as low as reasonably achievable* (ALARA) principle.[1]

Precautions should be taken to reduce ionizing radiation in the Cath-Lab: (a) minimizing the use of cine and steep angles of X-ray beam; (b) minimizing the use of magnification modes; (c) minimize frame rate of fluoroscopy and cine; (d) using collimation; (e) maintaining the image detector close to the patient; and (f) monitoring the ionizing radiation dose in real-time.[1,2]

Following the same ALARA philosophy, the concept of ''diagnostic reference level'' (DRL), first introduced by the International Commission on Radiological Protection in 1996 and endorsed by the European Commission, is defined as ''*a form of investigation level used as a tool to aid optimization of protection in the medical exposure examinations in diagnostic and interventional procedures*''.[6,7] DRLs are therefore quantity measures, expressed as numerical values, that assess the amount of radiation used in a radiological procedure.[6,7] In interventional radiology procedures, multiple-dose descriptors have been proposed as DRL quantities, such as the KAP, the air kerma at the

* Corresponding author.
E-mail address: danielssagomes@gmail.com (D.A. Gomes).

https://doi.org/10.1016/j.repc.2024.02.002

patient entrance reference point (Ka,r), fluoroscopy time, and number of frames.[6–9] Numerically, DRL is defined as the 75th percentile value of the distribution of a dose quantity descriptor. Reviewing local DRLs is recommended every three to five years, as the emergence of new technology, imaging techniques, and the use of DRLs themselves to optimize radiation protocols may lead to changes in their values over time.[7] Against this background, previous surveys have been conducted in several countries and internationally to estimate collective doses and to establish DRLs.[6–9]

In this study by *Costa et al.*, the authors aimed to describe radiation exposure during complex PCI (defined as CTO or left main stem; LMS) and to set the respective DRLs.[10] A total of 242 patients were included at a single center from 2019 to 2020, both in the context of acute or chronic coronary syndromes. DRLs in this setting were set in Ka,r 3012 mGy, and KAP 162 Gy cm^2. Furthermore, the authors also reported achievable doses (AD; Ka,r 1919 mGy; KAP 101 Gy cm^2) which correspond to the 50th percentile of the dose distribution. In this setting, ADs refer to doses to be achieved in a future assessment, to encourage Cath-Labs to reduce radiation exposure. These results, however, should be analyzed considering the limitations of the study design. Firstly, this was a single-center study with a small sample size. Furthermore, given that complex PCI was defined exclusively as CTO or LMS disease, and that patients with unsuccessful PCI (which may indicate more complex and prolonged procedures) were excluded from the analysis, the radiation exposure doses reported might be underestimated. Despite these limitations, for the first time, local DRLs in a Portuguese Cath-Lab were established. This important study should encourage other Cath-Labs to determine their DRLs, with a view to establishing national DRLs for interventional cardiology procedures.

Conflicts of interest

Nothing to declare.

References

1. Hirshfeld JW Jr, Balter S, Brinker JA, et al. ACCF/AHA/HRS/SCAI clinical competence statement on physician knowledge to optimize patient safety and image quality in fluoroscopically guided invasive cardiovascular procedures: a report of the American College of Cardiology Foundation/American Heart Association/American College of Physicians Task Force on Clinical Competence and Training. Circulation. 2005;111:511–32.
2. Picano E, Vano E. The radiation issue in cardiology: the time for action is now. Cardiovasc Ultrasound. 2011;9:35.
3. Gutierrez-Barrios A, Cañadas-Pruaño D, Noval-Morillas I, et al. Radiation protection for the interventional cardiologist: practical approach and innovations. World J Cardiol. 2022;14:1–12.
4. Costa H, Vinhas H, Calé R, et al. A report on a survey among Portuguese Association of Interventional Cardiology associates regarding ionizing radiation protection practices in national interventional cath-labs. Rev Port Cardiol. 2023, http://dx.doi.org/10.1016/j.repc.2023.07.008.
5. Padovani R, Vano E, Trianni A, et al. Reference levels at European level for cardiac interventional procedures. Radiat Prot Dosimetry. 2008;129:104–7.
6. Sánchez R, Vañó E, Fernández Soto JM, et al. Updating national diagnostic reference levels for interventional cardiology and methodological aspects. Phys Med. 2020;70:169–75.
7. Sanchez RM, Siiskonen T, Vano E. Current status of diagnostic reference levels in interventional cardiology. J Radiol Prot. 2022;42, http://dx.doi.org/10.1088/1361-6498/aca2b3.
8. Schegerer AA, Frija G, Paulo G, et al. Radiation dose and diagnostic reference levels for four interventional radiology procedures: results of the prospective European multicenter survey EUCLID. Eur Radiol. 2021;31:9346–60.
9. Stocker TJ, Abdel-Wahab M, Möllmann H, et al. Trends and predictors of radiation exposure in percutaneous coronary intervention: the PROTECTION VIII study. EuroIntervention. 2022;18:e324–32.
10. Costa H, Espírito-Santo M, Bispo J. Ionizing radiation exposure in complex percutaneous coronary intervention: defining local dose reference levels in the catheterization laboratory. Rev Port Cardiol. 2024, http://dx.doi.org/10.1016/j.repc.2023.10.010.