

Do we have enough radiation protection in cardiology?

¿Tenemos suficiente protección radiológica en cardiología?

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The procedures of interventional cardiology provide an unquestionable benefit for patients who suffer from heart disease but require the intensive use of ionizing radiations that are somehow risky for the patients and the healthcare providers who participate in these interventional procedures. The radiological protection programs should be an important part of the quality systems used in this medical practice.

Should we be worried about the reported cases of radiation-induced skin lesions in patients, or about the radiation-induced cataracts or brain tumors suffered by some interventional surgeons? The answer is "no" but only as long as we are aware of the risks involved when using ionizing radiations, the radiological protection measures available, and know how to use them appropriately. The radiation dose levels that patients and healthcare providers receive should be measured, recorded and audited periodically and the necessary correcting measures implemented when these levels are high.

A question that any interventional cardiologist should be able to answer is whether he knows what doses of radiation are his patients receiving and what occupational doses of radiation is his personal dosage-meter recording. If the answer is negative, then maybe he should be worried because if these levels were high, he would not know what correcting measures he should implement to reduce them.

INTERNATIONAL RECOMMENDATIONS ON RADIOLOGY PROTECTION IN RADIOLOGY

The International Commission on Radiological Protection (ICRP) and other international organizations and interventional cardiology and radiology societies have designed good clinical practice recommendations for the management of ionizing radiations.¹⁻³

The Spanish and European⁴ legislation require quality control programs for all x-ray machines and that the healthcare providers involved have proper radiological protection knowledge and are certified by the corresponding authority. Also, that the doses of radiation received by patients and professionals alike are measured and shared on a regular basis with the so-called reference levels for diagnostic purposes (when it comes to patients)⁵ and with radiation dose limits (when it comes to healthcare providers).

EFFECTS OF IONIZING RADIATION

Exposure to ionizing radiation can produce stochastic effects (probabilistic) and deterministic effects (also called tissue effects).⁶

The ICRP has recently proposed⁷ new dose thresholds of 0.5 Gy for the opacities of the crystalline lens (cataracts) and cardiovascular and cerebrovascular effects and has suggested a new dose threshold for occupational doses of 20 mSv/year for the crystalline lens, much lower than the previous levels of 150 mSv/year. This new threshold has already been included in the European legislation⁴, which translates into a stricter control of occupational doses for interventional healthcare providers.

RISKS OF RADIATION-INDUCED CATARACTS IN HEALTHCARE PROFESSIONALS AND SOME CASES OF BRAIN TUMORS

Over the last few years and long before the ICRP decided to propose a new dose threshold for radiation-induced lesions in the crystalline lens and bring the occupational dose limits down to 20 mSv/year, the International Atomic Energy Agency had already conducted several studies to evaluate radiation-induced opacities in cardiologists of Latin America, Asia, and Europe as part of their RELID (Retrospective Evaluation of Lens Injuries and Dose) program. The overall results showed a significant number of healthcare providers and nurse specialists with opacities that may have been caused by ionizing radiations after years working and not using the adequate radiological protection measures. In the dose estimates, healthcare professionals were found who may have received doses > 1 Gy in the crystalline lens through the years due to inadequate protection. The scarce use of personal dosage meters among professionals was studied too.⁸

If the overhead radiation shields present in almost all cath labs are not used correctly, the disperse radiation exposure of eyes (and head) can be substantial, especially if maintained over several years.

Several cases of brain tumors in interventional surgeons have also been published, although with scarce analyses on the occupational doses that these healthcare providers may have received.⁹

However, no epidemiological studies have been conducted so far that confirm the possible cause-effect relation and further

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research on this issue has been suggested.¹⁰ Recently, several studies have been published that rule out the connection between low doses of radiation and brain tumors.¹¹

NEW EUROPEAN REGULATIONS ON BASIC SAFETY STANDARDS

The recent Council Directive 2013/59/EURATOM on basic safety standards,⁴ that is actually in the process of transposition and implementation in countries of the European Union, stresses several aspects of radiological protection in interventional procedures. X-ray machines should show the dose that is being emitted to the patients while the procedure is being conducted and once it is over. Also, these doses should be shown in the procedural reports, at least in the new x-ray machines, and they should be compared to the reference levels for diagnostic purposes. Also, correcting measures should be implemented without delay if these levels are exceeded.

If the doses of radiation received by the patients turn out to be high with the corresponding risk of causing radiation-induced lesions to the skin, then quality assurance programs with the appropriate clinical follow-up should be taken into consideration. Also, patients should be informed.

RADIATION DOSES IN INTERVENTIONAL CARDIOLOGY IN SPAIN

The European and Spanish legislations establish that the dose of radiation received by populations medically exposed to ionizing radiations should be measured. Based on the results from the activity registries found by the Working Group on Hemodynamics and Interventional Cardiology of the Spanish Society of Cardiology (SEC) and the DOCCACI (Dosimetry and quality criteria in interventional cardiology) program¹² the contribution of interventional cardiology to the overall radiation dose in Spain¹³ has been estimated and quantified in 4% of the total use of x-ray machines in medicine. The overall dose per inhabitant derived from interventional cardiology procedures stands at around 0.03 mSv per inhabitant/year. This value is the same as the value found in the United Kingdom, it is half the value found in Switzerland (0.06 mSv), and six times higher than the value found in Germany and the United States (0.2 mSv).¹³

WHAT SHOULD WE DO TO WORK SAFELY WITH IONIZING RADIATIONS?

Since we cannot improve what we are not measuring or what we do not know, we need to stress here how important it is to always use personal dosage meters and elements for personal protection, while paying special attention to the occupational dose levels we are receiving.

All interventional teams have devices available that inform them on the dose of radiation received by the patients. We should be

paying attention to these dose levels and compare them periodically with the reference levels regularly updated by the Working Group on Hemodynamics and Interventional Cardiology of the Spanish Society of Cardiology (SEC) through the DOCCACI program.¹²

Also, we should take advantage of the collaboration from specialists on medical physics (or hospital radiophysicists) that the new European Council directive has included as necessary for interventional procedures.

CONFLICTS OF INTEREST

The author declared no conflicts of interest whatsoever with respect to this study.

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