Radiation risk from lung cancer screening

Cristiano Rampinelli[1], Paolo De Marco[2], Massimo Bellomi[1]

[1]Department of Medical Imaging and Radiation Sciences, [2]Division of Medical Physics, European Institute of Oncology, Milan, Italy

Correspondence to: Cristiano Rampinelli. Department of Medical Imaging and Radiation Sciences, European Institute of Oncology, Milan, Italy. Email: cristiano.rampinelli@ieo.it.

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We have read with interest the editorial of Mascalchi and colleagues, on our study "*Exposure to low dose computed tomography for lung cancer screening and risk of cancer*: *secondary analysis of trial data and risk-benefit analysis*" (1).

Their comments are certainly pertinent and clearly present the state-of-the-art concerning cancer risk associated with low-dose radiation exposure. This topic is however controversial and the scientific community recognize that much of low-dose radiation risk is still unknown, with a significant level of uncertainty in the definition of actual risk for subjects that undergo low-dose CT for lung cancer screening.

In particular, there are several aspects to be considered when evaluating the quantitative risk from low-dose radiation exposure. In fact, the risk-benefit analysis of low-dose CT screening is very much influenced by the risk profile and age of the subject, by the design of the screening program and by the CT technology used (with particular regard to scanning parameters).

The reduction of radiation risk in CT screening begins from an optimal patient selection (subjects at higher risk) and the definition of an accurate study design, which are essential for minimizing unnecessary radiation exposure.

Our study reported a median cumulative effective dose at the 10th year of screening of 9.3 mSv for men and 13.0 mSv for women. The overall additional risk of induced major cancers was low (0.05%; 2.4 major cancers theoretically induced over 5,203 screened subjects), with a greater risk for women aged 50–54 [lifetime attributable risk (LAR) of major cancers was about three-fold higher than for men aged 65 or more]. Most importantly, we estimated 1 radiation induced major cancer every 108 lung cancers detected (1).

Risk estimates performed in our study can be considered substantially low, even if we use the BEIR VII Report (2) and the linear no-threshold (LNT) model, for which the inferred risk at lower doses probably overestimates the risk of cancer induction. In fact, the LAR of the BEIR VII has been estimated from the data obtained from the atomic bomb survivors and from the nuclear energy industry workers, exposed to doses much higher than those associated with LDCT screening. Cancer risk related to radiation exposure has therefore been extrapolated from high-dose to low-dose levels, using a LNT model.

Observational, experimental and radiobiological data may show, however, that LNT might underestimate or overestimate the risk from low-dose radiation. Moreover, a part of the scientific community claims that there is a threshold and warns against risk estimation when dealing with doses below a certain level (50–100 mSv), as the risk might be too small to be observed or even non-existent (3). The risk of radiation-induced cancer is still controversial, with the LNT model representing a cautionary approach that overestimates the risk related to low-dose radiation exposure (4).

What we should take into consideration when interpreting the results of our study is that we did not use iterative reconstruction algorithms and dose-reduction techniques: such advances in CT technology (currently implemented in all modern scanners) can dramatically reduce the radiation

dose delivered to patients. Several studies, for example, have reported a dose reduction of up to 80% with iterative reconstruction, while achieving the same image quality as with FBP, with sub-milliSievert effective dose (below 0.2 mSv) (5,6). Considering the LNT model, then, the risk of radiation induced cancer, would be reduced to the same extent, up to 80%.

Another topic of growing interest, in our opinion, is the use of advanced software for the calculation of organ doses and hence effective doses (7). In fact, the dose delivered to patients depends on scanning parameters and on the size of the patient: software that uses different phantoms to estimate organ doses might be more accurate than those that use the standard reference patient only.

In conclusion, we firmly believe that the benefit of lung cancer screening in terms of mortality reduction outweighs the risk of radiation-induced cancer, and recent advances in CT technology will further reduce the radiation risk associated with low-dose CT.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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