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Response to Castellano and Nicol

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We thank Drs. Castellano and Nicol for their interest in our paper, and their many insightful comments which focus specifically on radiation dose to patients undergoing cardiovascular CT. Three central themes of their letter are the challenges involved in estimating effective dose (ED) from dose-length product (DLP), the present lack of and need for diagnostic reference levels (DRLs) for cardiovascular CT, and the great variability in radiation doses from coronary CT angiography (CCTA). We share all of these concerns.

The thoracic conversion factors of 0.017 and 0.014mSv×mGy^{-1}×cm^{-1}, which are routinely used in the literature, are indeed inadequate for estimating ED from CCTA, resulting in substantial underestimation. As we've previously pointed out(1), these were derived from Monte Carlo simulations of ancient single-slice scanners incapable of performing CCTA, and using an older definition of ED. Drs. Castellano and Nicol's figure is a wonderful illustration of why ED from CCTA should be higher than that from a chest CT with the same DLP. In any event, just because radiation dose is difficult to estimate doesn't mean that it shouldn't be openly discussed with patients, especially since it is on the public's mind so much. We are currently working on a more accurate approach for estimation of ED from DLP for CCTA, for virtually all contemporary scanners.

One of the goals of our paper was to stimulate the awareness of a need for DRLs in all cardiovascular procedures involving ionizing radiation, of which CCTA is an important example. This is an area in which the cardiology community has fallen behind other fields, e.g. pediatric radiology. DRLs for individual examinations are often framed in terms of the 75th percentile of the distribution of patient doses in a particular population. However with such high between-center variability as pointed out by Drs. Castellano and Nicol, careful thought needs to go into the most constructive approach for developing such reference levels. If a population-based 75th percentile threshold were used uniformly, in some labs

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most patients would be flagged as exceeding the DRL and consequently the concept of DRL could be rendered of little use for patient radiation protection.

Another important implication of the great variability in radiation doses is that, in real-world practice, doses may not be nearly as low as those reported by experts using the latest equipment in selected patient populations, and thus, to paraphrase Mark Twain, rumors of the demise of the "radiation problem" in cardiac imaging have been greatly exaggerated. The UK laboratories' median CCTA DLP range of 200 to 1000 mGy*cm suggests that, using a cardiac-specific conversion factor, the median CCTA ED at these sites ranged from ∼5 to 30 mSv. The existence of such dose levels in contemporary practice underscores both the need for continued efforts to reduce doses to patients, and the need for patient-centered imaging, shared decision making, and better communication with our patients.

Acknowledgments

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