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EDITORIAL COMMENT

320-row CT scanning: reduction in tube current parallels reduction in radiation exposure?

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Nowadays, multiple studies involving over several thousands of patients have established that CT angiography is a highly accurate noninvasive approach for delineation of the presence and severity of coronary atherosclerosis [1–35]. With its high negative predictive value cardiac CT is optimally suited for the evaluation of patients with a low or intermediate risk of coronary disease, allowing the non-invasive exclusion of coronary disease at relatively low cost and risk [36–48]. However, the appropriate radiation dose remains an important issue in cardiac CT. On one hand, a too low radiation dose may result in a high level of image noise and therefore in non-evaluable images. On the other hand, using higher radiation exposure levels may put patients at unnecessary risk of radiation damage [49–58]. Effective strategies to reduce radiation dose, such as prospective gating, ECG-correlated modulation of the tube current, and tube voltage below 100 kV, are becoming more and more available [59–65]. Leschka et al. [61] showed that adjustment of the scan length of CT coronary angiography using the images from calcium scoring instead of the scout was associated with a 16% reduction in radiation dose of dual-source CT coronary angiography. In a large multicenter study of coronary CT angiography in patients with excellent heart rate control, Labounty et al. [62] reported that the use of minimal padding (i.e. additional surrounding X-ray beam on time), was associated with a substantial reduction in radiation dose (from mean 5.7 mSv to mean 2.0 mSv) together with preserved image interpretability. Rogalla et al. [63] showed that the anterior-posterior diameter adapted tube current in dynamic volume CT coronary angiography provided a new simple and practical approach to keep image quality constant by accounting for differences in patient size. Maintaining a constant image quality in CT, independent of patient body habitus, significantly contributed to a substantially improved diagnostic image quality together with a reduced radiation dose for the patient. Blankstein et al. [64] investigated the effective radiation dose and image quality of 100 kV versus 120 kV tube voltage among patients referred for cardiac dual source CT imaging in 294 consecutive patients. They convincingly demonstrated that use of low kV resulted in a substantial reduction of radiation dose without compromising image quality. The effective radiation dose for the 100 and 120 kV scans was 8.5 and 15.4 mSv, respectively. In the recently published PROTECTION II trial, Hausleiter et al. [65] studied 400 non-obese patients undergoing CT angiography with either 100 or 120 kV CT

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angiography. The study specifically examined the impact of a reduction in tube voltage to 100 kV using 64-slice CT angiography systems from three different manufacturers. It was demonstrated that a further 31% reduction in radiation exposure could be obtained with 100 kV tube voltage settings while image quality was preserved.

In the current issue of the *International Journal of Cardiovascular Imaging*, Zhang et al. [66] prospectively evaluated image quality parameters, contrast volume and radiation dose at the 100 kV tube voltage setting during CT coronary angiography. Interestingly, the authors used a 320-row CT scanner. The authors studied 107 consecutive patients with a heart rate <65 beats per minute who underwent prospective ECG-triggered CT coronary angiography. A total of 40 patients with a body mass index <25 kg/m^2 were scanned using 100 kV tube voltage settings, whereas 67 patients were scanned using the 120 kV protocol. Contrast-to-noise ratios and contrast material volumes were calculated. Adequate diagnostic image quality was achieved in 98.2% of coronary segments with 100 kV CT coronary angiography, and in 98.6% of coronary segments with 120 kV CT coronary angiography, without significant differences in image quality scores for each coronary segment. Vessel attenuation, image noise, and contrast-to-noise ratios were not significantly different between the 100 kV and 120 kV protocols. Mean contrast injection rate and mean material volume were significantly lower for the 100 kV tube voltage setting than for the 120 kV protocol. The effective radiation dose was 2.12 ± 0.19 mSv for 100 kV CT coronary angiography, which is a reduction of 54% compared to 4.61 ± 0.82 mSv for 120 kV CT coronary angiography. A 100 kV CT coronary angiography can be implemented in patients with a body mass index <25 kg/m^2. The 100 kV setting allowed significant reductions in contrast material volume and effective radiation dose while maintaining adequate diagnostic image quality.

The interesting study by Zhang et al. [66] represents the first evaluation by a 320-row CT scanner of the 100 kV protocol for CT coronary angiography with respect to image quality, contrast volume, and radiation exposure. This is an appropriate and timely approach, as the use of 320-row MSTC scanners is increasing over the past years [67–71]. In principle, whole-heart 320-row CT angiography avoids exposure-intensive overscanning and overranging, offering the potential to significantly reduce radiation dose. The main results of the present study indicate that 100 kV CT coronary angiography using a 320-row scanner is feasible in patients with a body mass index of <25 kg/m, visualizing more than 98% of coronary segments with appropriate diagnostic image quality**.** A dose reduction of even 54% for the 100 kV tube setting was reached**.** The image quality was reduced by motion artifacts in nearly 21% of segments. However, this held for both the 100 kV and the 120 kV tube voltage settings. Blurring by calcification was more common for the 100 kV protocol than for the 120 kV protocol. Theoretically, the 100 kV voltage setting may increase blooming artifacts from dense structures such as calcification, which precludes accurate evaluation of the lumen of the coronary arteries. Consequently, future studies using the 100 kV protocol should focus on the influence of calcification on image quality, and the potential interference of the 100 kV protocol with edequate evaluation of both coronary arteries and coronary stenoses, especially for calcified segments and identification of soft plaques.

To conclude, Zhang et al. [66] have clearly demonstrated that for patients with a body mass index of <25 kg/m^2, 100 kV CT coronary angiography can be validly performed using a 320-row CT scanner. This approach allows a significant reduction of 54% in contrast and radiation doses, while maintaining adequate diagnostic image quality. The study extends previous findings that the reduction in tube current may be a feasible standard addition to the other strategies for reducing potential radiation exposure in patients undergoing CT coronary angiography.

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