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EDITORIAL COMMENT

Use of the anterior-posterior chest diameter in CT: reduction in radiation dose?

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In recent years, computed tomography (CT) angiography has emerged as a reliable non-invasive method for the assessment of coronary artery disease, coronary anatomy and cardiac function [1–17]. Multiple studies involving over several thousands of patients have established that CT angiography is highly accurate for delineation of the presence and severity of coronary atherosclerosis [18–23]. CT angiography may also reveal the total plaque burden, i.e. both calcified and non-calcified components, for individual patients with coronary atherosclerosis [24–35]. With its high negative predictive value cardiac CT is best suited to 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 [20, 36–47]. However, the appropriate radiation dose remains an important issue in cardiac CT. A too low radiation dose may result in a high level of image noise and therefore in non-evaluable images. Conversely, using higher radiation exposure levels may put the patient at unnecessary risk of radiation damage [48–56].

Editorial comment on the article of Rogalla et al. (doi: 10.1007/s10554-010-9630-3)

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In the current issue of the *International Journal of Cardiovascular Imaging*, Rogalla et al. [57] compared tube current adaptation based on three body mass index categories versus the anterior-posterior chest diameter for radiation dose optimization in patients undergoing dynamic volume cardiac CT. The anterior-posterior chest diameter of the patient's chest was chosen as a means to individualize the required tube load in cardiac CT with the aim of reducing inter-individual variation in technical image quality. Two cardiac imaging centers participated in the study which comprised a total of 40 evaluable patients. Twenty patients underwent a prospectively triggered 320-slice single beat cardiac CT using the X-ray tube current (mA) manually adjusted to the patient's body mass index (group I). In 20 subsequent patients, the tube current was adapted according to the patient's anterior-posterior chest diameter (group II). All other parameters were kept constant. Image noise was defined as the standard deviation of attenuation values and measured using a region of interest in the descending aorta. Variation in image noise was statistically compared between both patient groups. Average and standard deviation of pixel noise were 29.1 and 14.8 Hounsfield Units in group I and 28.0 and 4.2 Hounsfield Units in group II. Inter-individual variation of pixel noise was significantly lower in group II versus group I.

The authors concluded that tube current adaptation based on anterior-posterior chest diameter was superior to stepwise adaptation based on body mass index for optimizing radiation dose in dynamic volume cardiac CT. Therefore, this approach limits unnecessary radiation dose while ensuring diagnostic image quality in patients with diverse body habitus. The current study at least suggests that tube current adaptation to the patient's chest diameter is better suited for constant technical image quality than adaptation to the body mass index in three categories. Since individual variation of noise values are reduced with the anterior-posterior chest diameter technique, smaller patients receive less radiation dose whereas larger patients achieve improved image quality. The authors propose a simple method to account for variations in thoracic dimension between patients in order to predict the required tube settings for CT coronary angiography, thereby reducing inter-individual variation in image quality. This method ensures the lowest radiation dose for every individual, at the same time preserving adequate diagnostic image quality.

Currently, there are pressing questions about radiation safety of cardiac CT scans. The median exposure of CT angiography is roughly equivalent to 600 chest X-rays (12 mSv). Traditional angiography exposes patients to roughly half the dose of CT angiography. However, the radiation exposure of almost 2,000 people having 64-slice cardiac CT images at 50 medical centers in different countries may vary more than sixfold [58]. Effective strategies to reduce radiation dose, such as prospective gating, ECG-correlated modulation of the tube current, and tube voltage below 100 keV, are becoming more and more available. In a recent paper by Leschka et al. [59], it was shown 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. [60] 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 together with preserved image interpretability. Nonetheless, heart imaging tests should be used cautiously to minimize patient exposure to ionizing radiation. Cardiac imaging studies exposing patients to ionizing radiation should be ordered only after thoughtful consideration of the potential benefits to the patient, thereby keeping in line with the established so-called 'appropriateness' criteria. In recent years, for all cardiac imaging modalities appropriateness criteria have been established with the primary aim to adhere to the primary indications. As to CT angiography, Ayyad et al. [61] showed that the number of appropriate CT examinations increased from 69.5 to 78.5% during the period from 2006 to 2007, whereas the number of inappropriate examinations decreased from 11.5 to 4.6%. Interestingly, cardiologists were more likely than non-cardiologists to order CT examinations that were appropriate during the study period. However, a more recent study by Miller et al. [62] suggested that still a significant proportion (46%) of the coronary CT angiography studies are for indications not covered by the published appropriateness criteria. Adherence to the appropriateness criteria is of paramount importance in clinical practice. This policy will have a significant impact on physician decision making and patient care, such as exposure to a minimal radiation dose.

To summarize, the anterior-posterior chest diameter adapted tube current in dynamic volume CT coronary angiography, as proposed by Rogalla et al. [57], provides 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 contributes to a substantially improved diagnostic image quality together with a reduced radiation dose for the patient.

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