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EDITORIAL COMMENT

Functional analysis by 64-slice CT scanning: prediction of left ventricular dysfunction together with reduction in radiation exposure?

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CT coronary angiography has shown to be a highly accurate noninvasive approach for delineation of the presence, location and severity of coronary artery disease [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]. Nevertheless, 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 [59–62]. In the recently published PROTECTION II trial, Hausleiter et al. [63] studied 400 non-obese patients undergoing CT angiography with either 100 or 120 kV CT 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. Gerber et al. [64] produced a scientific statement on radiation doses from the American Heart Association. The authors estimated the doses for retrospective CT coronary angiography at 15 mSv without tube modulation, 9 mSv with dose modulation and 3 mSv for prospectively acquired studies. With either prospective or retrospective ECG tube current modulation, radiation exposure can be minimized and yet high quality imaging can be maintained. Dual-source multi-detector CT allows excellent temporal resolution (83 ms) with improvements in image quality despite increased heart rates. Dual-source multi-detector CT using ECG tube current modulation and retrospective gating exhibit radiation doses in the range of 7–9 mSv which can be further reduced by using a tube voltage of 100 kV in patients with a body mass index < 35 kg/m^2. With prospective gating and the use of 100 kV in low body mass index patients, it is possible to reduce the average radiation dose to 2.1 ± 0.6 mSv [65, 66].

In the current issue of *The International Journal of Cardiovascular Imaging,* Gupta et al. [67] evaluated the correlation between left ventricular (LV) volumes i.e. both LV end-diastolic volume (LVEDV) and

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LV end-systolic volume (LVESV) and LV ejection fraction (LVEF) using 64-slice multi-detector CT scanning. They also determined the accuracy of all the LV volume parameters to detect LV systolic dysfunction. The feasibility of using LV volume as a surrogate of LV systolic dysfunction on prospectively gated imaging was studied to prevent the radiation exposure of retrospective imaging. A total of 568 patients underwent 64-slice multi-detector CT. Patients were divided into 2 groups: group (1) subjects without heart disease and LVEF $\geq$ 50%; and group (2) patients with coronary artery disease and LVEF $<$ 50%. The LV volumes (LV cavity only) and total LV volumes (cavity + LV mass) at end-systole and end-diastole (LVESV, total LVESV, LVEDV and total LVEDV) were measured. The upper limit values of all LV volume parameters in group 1 were used as the reference standard to diagnose LV systolic dysfunction in group 2. The authors found an exponential correlation between LVEF and all the LV volume parameters. The specificity to detect LV systolic dysfunction in group 2 was $>$ 90% and the sensitivity was 88.9, 83.3, 61.3 and 74.9% for LVESV, total LVESV, LVEDV, and total LVEDV, respectively. The authors concluded that systolic and diastolic LV volumes had a high correlation with LVEF and a high accuracy to detect LV systolic dysfunction.

As prospectively triggered scans do not allow the measurement of LV systolic dysfunction [68], calculation of LV volumes could provide important information as to the presence of possible LV dysfunction without exposing the patient to the radiation dose of retrospective imaging. Importantly, however, in a prospective triggered scan, depending on patient's heart rate and its regularity, the single acquired phase is usually neither the LVEDV nor the LVESV. In a similar context, de Graaf et al. [69–71] evaluated the diagnostic ability of 320-row CT in 64 patients with known or suspected coronary artery disease who were scheduled for invasive coronary angiography. Prospective ECG gating was used in all patients. The mean radiation dose was dependent on the ECG interval acquired: 75% of the RR interval had 3.9 $\pm$ 1.3 mSv, 65–85% of the RR interval resulted in a higher dose of 6.0 $\pm$ 3.0 mSv. However, analysis of LV function required the acquisition of the whole RR interval (25% of maximum tube current outside of the 65–85% RR interval) which was associated with the highest dose of 10.8 $\pm$ 2.8 mSv. In that respect, it would have been worthwhile to study the CT volumes in the prospectively acquired range (typically 75%) of the RR-interval. Furthermore, it would be of interest to compare these values with CMR, which is considered to be the gold standard for LV function analysis.

To summarize, Gupta et al. [67] nicely demonstrated that the use of ventricular volumes as a marker of LV systolic dysfunction at 64-multi-detector CT could lead to a significant radiation dose reduction in comparison to getting a retrospective ECG-gated CT scan for the same information. LVESV turned out to be the most accurate parameter in detecting LV systolic dysfunction. Since multi-detector CT-derived LV volumes were easy to measure and highly reproducible, they can be used for early detection of LV systolic dysfunction in addition to LVEF. Consequently, using prospectively triggered imaging, one may assess ventricular volumes in order to predict the occurrence of LV dysfunction in patients with coronary artery disease together with a reduction in radiation exposure.

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