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FULL PAPER

Ultra-low-dose dual-source CT coronary angiography with high pitch: diagnostic yield of a volumetric planning scan and effects on dose reduction and imaging strategy

[1]M H MAURER, MD, [2]B HAMM, MD, [2,3]A HUPPERTZ, MD and [2]A LEMBCKE, MD

[1]Department of Radiology, Bern University Hospital, Inselspital, Bern, Switzerland
[2]Department of Radiology, Charité—Universitätsmedizin Berlin, Berlin, Germany
[3]Imaging Science Institute Charité, Berlin, Germany

Address correspondence to: Dr Martin H Maurer
E-mail: martin.maurer@insel.ch

Objective: To evaluate the role of an ultra-low-dose dual-source CT coronary angiography (CTCA) scan with high pitch for delimiting the range of the subsequent standard CTCA scan.

Methods: 30 patients with an indication for CTCA were prospectively examined using a two-scan dual-source CTCA protocol (2.0 × 64.0 × 0.6 mm; pitch, 3.4; rotation time of 280 ms; 100 kV): Scan 1 was acquired with one-fifth of the tube current suggested by the automatic exposure control software [CareDose 4D™ (Siemens Healthcare, Erlangen, Germany) using 100 kV and 370 mAs as a reference] with the scan length from the tracheal bifurcation to the diaphragmatic border. Scan 2 was acquired with standard tube current extending with reduced scan length based on Scan 1. Nine central coronary artery segments were analysed qualitatively on both scans.

Results: Scan 2 (105.1 ± 10.1 mm) was significantly shorter than Scan 1 (127.0 ± 8.7 mm). Image quality scores were significantly better for Scan 2. However, in 5 of 6 (83%) patients with stenotic coronary artery disease, a stenosis was already detected in Scan 1 and in 13 of 24 (54%) patients with non-stenotic coronary arteries, a stenosis was already excluded by Scan 1. Using Scan 2 as reference, the positive- and negative-predictive value of Scan 1 was 83% (5 of 6 patients) and 100% (13 of 13 patients), respectively.

Conclusion: An ultra-low-dose CTCA planning scan enables a reliable scan length reduction of the following standard CTCA scan and allows for correct diagnosis in a substantial proportion of patients.

Advances in knowledge: Further dose reductions are possible owing to a change in the individual patient's imaging strategy as a prior ultra-low-dose CTCA scan may already rule out the presence of a stenosis or may lead to a direct transferal to an invasive catheter procedure.

In recent years, dramatic advances in CT technology have led to the establishment of CT coronary angiography (CTCA) as a non-invasive imaging modality with robust image quality for the detection of coronary artery stenosis.[1,2] A major drawback of CT is the radiation exposure, which may be as high as 20 mSv.[3,4] Several techniques are available to reduce the radiation dose to the patient, including electrocardiography (ECG)-based tube current modulation, automatic exposure control and prospective ECG gating.[5–7] State-of-the-art dual-source CT scanners, which use two radiation sources and detectors, provide markedly better resolution and, in conjunction with fast table advancement, enable image acquisition of the entire heart in a single heartbeat.[8] This technique requires no overlapping acquisition and—under ideal conditions, that is, in patients with low heart rates—can reduce radiation exposure to <1 mSv.[9]

While these techniques can already substantially lower the radiation exposure of patients undergoing CTCA, there is potential for further reduction by optimally planning the scan length in the *z*-axis. An anteroposterior view acquired for localization of the imaging volume provides only a general idea of the course of the coronary arteries within the cardiac silhouette. Therefore, in order to ensure coverage of the entire coronary system, most examiners define the scan length using the tracheal bifurcation as the upper limit and the lateral diaphragmatic recess as the lower limit.[10] In many cases, this strategy results in a longer scan and higher radiation exposure than is actually needed. An option for more accurate delimitation of the scan length is to use the axial slices of a prior calcium scan for orientation.[11,12] Alternatively, an accurate definition of the necessary scan length is achieved by acquiring a contrast-enhanced ultra-low-dose planning scan that might allow for a simultaneous

Table 1. Characteristics of the study population ($n = 30$)

Characteristic	Value
Number of patients	$n = 30$
Age	58.9 ± 13.1 years (range, 30–84 years)
Sex	14 males, 16 females
Height	1.71 ± 0.09 m (range, 1.56–1.89 m)
Weight	83.8 ± 16.9 kg (range, 52–119 kg)
Body mass index	28.5 ± 4.9 kg m^{-2} (range, 19.9–40.5 kg m^{-2})

diagnostic evaluation of at least the larger, proximal coronary artery segments, that is, those segments that are potentially amenable to a catheter-based intervention. We hypothesized that an ultra-low-dose planning scan can reduce the overall radiation exposure of CTCA: patients in whom the planning scan already excludes a stenosis would not need the subsequent diagnostic scan and patients in whom the planning scan detects at least one stenosis can directly undergo invasive cardiac catheterization.

The aim of our study was to investigate the use of a high-pitch ultra-low-dose dual-source CTCA scan for delimiting the scan range of the subsequent diagnostic CTCA, and to assess how such a scan might reduce radiation exposure and modify the imaging strategy in an individual patient.

METHODS AND MATERIALS

Patients

In this prospective single-centre study, we included a total of 30 patients (males, 14; females, 16; mean age, 58.9 ± 13.1 years; range, 30–84 years) with clinically suspected coronary artery disease and a clinical indication for CTCA. Criteria for performing CTCA and including patients into the analysis were a low-to-intermediate pre-test likelihood of coronary heart disease and a regular sinus rhythm with a heart rate of ≤65 beats per minute. Patients with a heart rate >65 beats per minute, a history of coronary artery intervention or contraindications to contrast medium were not included. Further demographic data of the study population [body weight, height, body mass index (BMI)] are shown in Table 1. The study was approved by the local ethics committee, and all patients gave written informed consent.

CT coronary angiography

All CTCA examinations were performed on a 64-row dual-source CT scanner (Somatom® Definition Flash; Siemens Healthcare, Forchheim, Germany). Patients with an initial heart rate >65 beats per minute received an oral β blocker 1 h before the examination (50 mg metoprolol) and were only included in the study if β blockade lowered their heart rate to ≤65 beats per minute. Following the positioning on the CT table and placement of an 18-gauge line into a cubital vein, each patient was given one or two puffs of sublingual nitroglycerin spray. The study protocol included two separate scans (Figure 1).

Figure 1. CT protocol with the length of Scan 1 based on the preceding radiogram and a scan length ranging from the tracheal bifurcation to 1 cm below the lower edge of the heart. If the lower edge was not visualized, the lateral diaphragmatic angle was used as the lower scan limit. The length of Scan 2 was based on Scan 1 plus 1 cm above the origin of the left coronary artery from the aorta and 1 cm below the apex of the heart to account for differences in inspiration depths.

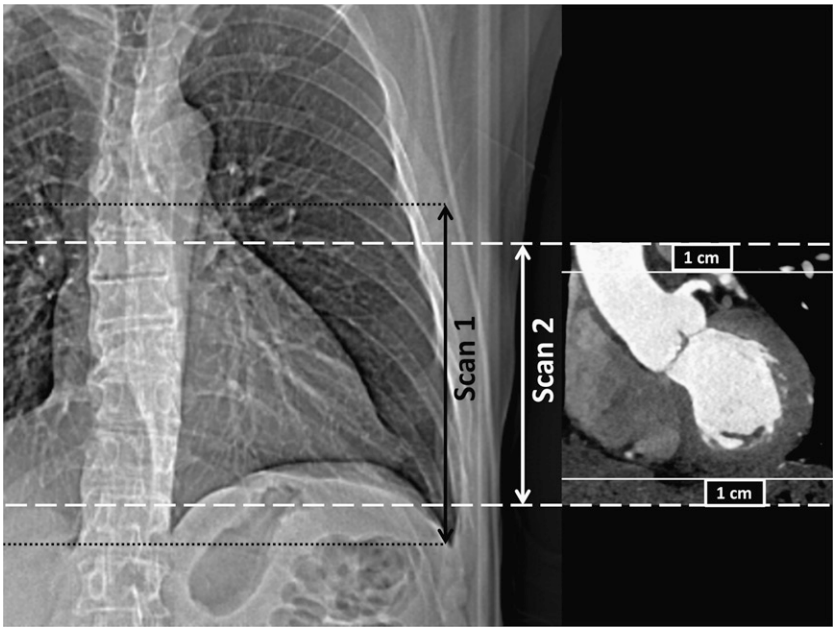


Table 2. Scan lengths of high-pitch dual-source CT coronary angiography scans: ultra-low-dose scan (Scan 1) and regular low-dose scan (Scan 2)

Value	Scan 1	Scan 2	*p*-value
Mean scan length (mm)	127.0 ± 8.71 (114–147)	105.1 ± 10.14 (93–133.5)	<0.05
Volume CT dose index (mGy)	0.84 ± 0.33 (0.42–1.55)	4.23 ± 1.76 (2.01–7.82)	<0.05
DLP (mGy cm)	15.7 ± 6.0 (9–27)	70.3 ± 28.65 (39–138)	<0.05
Mean effective radiation dose (mSv)[a]	0.27 ± 0.10 (0.15–0.46)	1.19 ± 0.49 (0.66–2.34)	<0.05

DLP, dose–length product.
Data shown as mean ± standard deviation (range).
[a]Calculation of the mean effective dose based on the DLP by using a conversion factor for the chest of 0.017 mSv (mGy cm)$^{-1}$.

Scan 1 (planning scan)

An intravenous (i.v.) bolus of contrast medium of approximately 40–50 ml (iopromide, Ultravist® 370; Bayer Healthcare, Berlin, Germany) was administered automatically (dual-head power injector, Stellant® D; Medrad Inc., Warrendale, PA) with a volume according to the patient's body weight. The dose was 200 mg iodine per kilogram of body weight injected over 10 s and followed by a 40-ml saline flush. The scan start was triggered at 60% of the R wave to R wave interval. Acquisition was started using bolus tracking (Care-Bolus; Siemens Healthcare, Erlangen, Germany). The threshold was 100 HU in a region of interest placed in the left atrium. The dual-source scan parameters were as follows: detector collimation of 2.0 × 64.0 × 0.6 mm with a resulting slice acquisition of 2.0 × 128.0 × 0.6 mm by means of a z-flying focal spot, 280 ms gantry rotation time, pitch of 3.4 and 100 kV tube voltage for each X-ray tube. The first scan was acquired as an ultra-low-dose scan with one-fifth of the tube current suggested by the implemented exposure control software CareDose 4D™ (Siemens Healthcare). Using a reference of 370 mAs, the software CareDose 4D adapts the radiation dose to the size and shape of the individual patient by proposing a tube current that is based on the X-ray attenuation in the initially acquired scout view of the chest. The scan range was planned on the basis of the preceding scout view and extended from the tracheal bifurcation to 1 cm below the lower edge of the heart. If the lower edge was not visualized, the diaphragmatic angle was used as the lower scan limit.

Scan 2 (standard of reference scan)

For the second scan, a second i.v. bolus of contrast medium was administered in the same way as for the first scan. The second

Table 3. Coronary segments assessed on Scan 1 and Scan 2 [proximal, mid and distal right coronary artery (RCA); left main coronary artery (LM); proximal and mid left anterior descending coronary artery (LAD); proximal left circumflex coronary artery (LCX)], and the first obtuse marginal branch (OM1, if of larger diameter, otherwise the mid LCX was assessed) and the ramus intermedius (RIM); mean and median image quality scores, and comparison of image quality scores of the two scans

Segment	Number of segments analysed in Scan 1 and 2	Median image quality score Scan 1	Median image quality score Scan 2	Number of segments with identical image quality scores	Number of segments with better score in Scan 2	Number of segments with better score in Scan 1
RCA						
Prox.	30	2	3	12	17	1
Mid	29	2	3	9	19	1
Distal	24	3	3	6	17	1
LM	30	2	3	16	13	1
LAD						
Prox.	29	2	3	14	15	0
Mid	29	2	3	16	13	0
LCX						
Prox.	29	2	3	11	18	0
Mid/ OM1	28	1	3	5	23	0
RIM	19	1	1	7	12	0
All	247	2	3	96	147	4

Prox., proximal.

Table 4. Analysis of stenosis detection in the nine coronary artery segments amenable to interventional procedures: number of stenoses detected with each scan [Scan 2 = standard of reference (SOR)] and number of true-positive, true-negative, false-positive and false-negative segments

Segment	Number of segments analysed in Scan 1 and 2	Number of segments with stenoses in Scan 1	Number of segments with stenoses in Scan 2 (SOR)	Scan 1 compared with Scan 2 (SOR) number of segments			
				Number of true positive	Number of true negative	Number of false positive	Number of false negative
Right coronary artery							
Prox.	30	0	0	0	30 (30/30, 100%)	0	0
Mid	29	1	1	1 (1/1, 100%)	28 (28/28, 100%)	0	0
Distal	24	0	0	0	24 (24/24, 100%)	0	0
Left main coronary artery	30	1	1	1 (1/1, 100%)	29 (29/29, 100%)	0	0
Left anterior descending coronary artery							
Prox.	29	5	3	2 (2/3, 66.7%)	23 (23/29, 79.3%)	3	1
Mid	29	5	4	4 (4/4, 100%)	24 (24/30, 80.0%)	1	0
Left circumflex coronary artery							
Prox.	29	2	2	1 (1/2, 50%)	26 (26/29, 89.7%)	1	1
Mid/first obtuse marginal branch	28	1	0	0	27 (27/28, 96.4%)	1	0
Ramus intermedius	19	0	0	0	19 (19/19, 100%)	0	0
All	247	15	11	9	230	6	2

Prox., proximal.

scan was performed with the regular tube current derived by the tube current modulation software (CareDose 4D). The scan range was defined on the basis of Scan 1, extending from 1 cm above the origin of the coronaries from the aorta to 1 cm below the lower cardiac border. All other scan parameters were the same as for the first scan.

For all patients, the scan length (in millimetres) and the CT dose index [volume CT dose index ($CTDI_{vol}$), in mGy] were documented. The effective dose of each scan was calculated from the dose–length product (DLP) provided by the scanner (in mGy cm) using the conversion factor of 0.017 mSv $(mGy\,cm)^{-1}$ for chest CT scans.[13,14]

Image analysis of CT coronary angiography

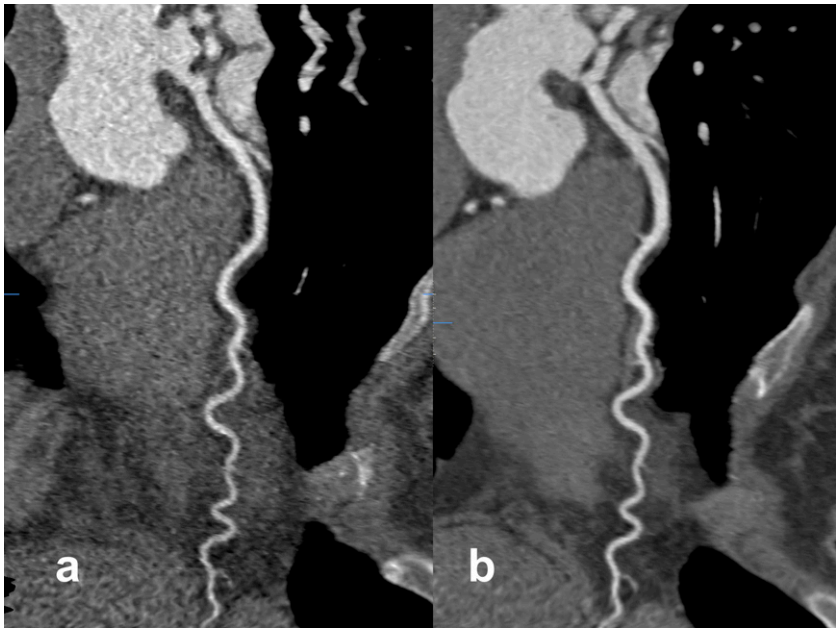
Images were reconstructed at 1.0-mm slice thickness with 0.5-mm overlap using a smooth reconstruction kernel (B20f). Acquired data sets were transferred to a separate workstation with dedicated software (Syngo®.via, Siemens Healthcare). All CTCA data sets were read by two readers in consensus (AL with over 10 years' experience and MM with 3 years' experience in evaluation of CT coronary angiograms) using axial slices and multiplanar vascular reconstructions. The following nine coronary artery segments, which are generally amenable to interventions, were evaluated: proximal, mid and distal right coronary artery (RCA) (pRCA, mRCA, dRCA); left main coronary artery (LM); proximal and mid left anterior descending coronary artery (pLAD, mLAD); proximal left circumflex coronary artery (pLCX); and the first obtuse marginal branch [OM1, if of larger diameter, otherwise the mid left circumflex coronary artery (mLCX) was assessed]; and the ramus intermedius (RIM), if present.

The image quality of each coronary segment was assessed on a four-point scale: three, excellent quality; two, slightly reduced quality with slight contour irregularity of the vascular wall, high diagnostic quality; one, more severe contour irregularity, but evaluation still possible; and zero, evaluation precluded owing to severe artefacts. Stenosis was defined as luminal narrowing of >50%.

Statistical analysis

Statistical analysis was performed using the SAS® 9.2 software package (SAS Institute Inc., Cary, NC). Continuous variables are given as mean ± standard deviation. Wilcoxon's signed rank test was used to compare mean scan lengths, $CTDI_{vol}$, DLPs and mean effective radiation doses. A p-value of <0.05 was considered

Figure 2. Example of the left main and left anterior descending coronary artery of a patient without stenosis. Scan 1 [(a) dose–length product (DLP), 10 mGy cm; effective dose, 0.17 mSv] would have been sufficient to rule out stenosis (true negative) compared with Scan 2 [(b) DLP, 46 mGy cm; effective dose, 0.79 mSv].



statistically significant. Ordinal parameters (image quality) and diagnostic parameters—sensitivity, specificity, positive-predictive value, negative-predictive value—are given as absolute and relative frequencies. For the diagnosis of stenotic segments, Scan 2 served as the standard of reference (SOR). Segments with adequate assessment in Scan 2 were included in the analysis (quality score ≥ 1). In the analysis of Scan 1, a segment was classified as true positive when a stenosis was diagnosed in Scan 1 and Scan 2, and a segment was classified as true negative when no stenosis was diagnosed in Scan 1 and Scan 2. Scan 1 was classified as false positive when a stenosis was diagnosed in this scan but not in Scan 2 and as false negative when no stenosis was diagnosed in Scan 1 while a stenosis was diagnosed in Scan 2. For the parameters of diagnostic accuracy, 95% confidence intervals (CIs) were calculated on a per-segment level using logistic regression on the basis of generalized estimating equations and taking correlation of multiple observations per patient into account. In a second analysis, diagnostic parameters were calculated on a per-patient basis. In this case, 95% CIs were calculated using the Clopper–Pearson method.

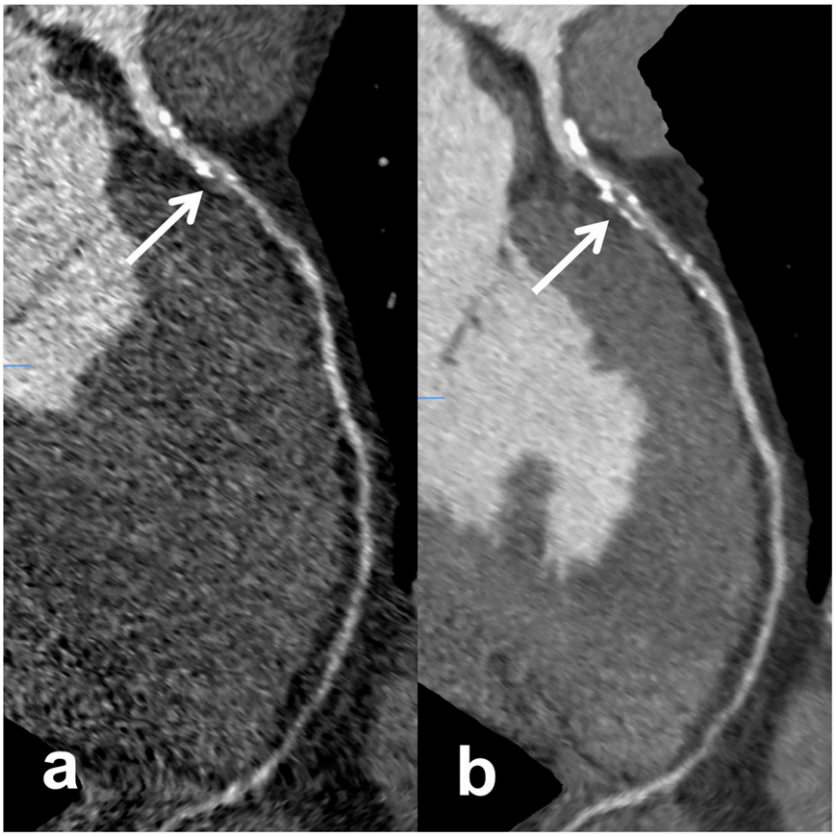
RESULTS

Both Scan 1 (ultra-low-dose planning scan) and Scan 2 (standard-dose scan, SOR) were technically successful in all patients. The mean scan length was 127.0 mm for Scan 1 and 105.1 mm for Scan 2 resulting in the scan length difference of 21.9 mm ($p < 0.05$; Table 2). The DLP was 15.7 ± 6.0 mGy cm (9–27 mGy m) for Scan 1 and 70.3 ± 28.65 mGy cm (39–138 mGy cm) for Scan 2, respectively. Consequently, the calculated mean effective radiation dose was 0.27 ± 0.10 mSv (0.15–0.46 mSv) and 1.19 ± 0.49 mSv (0.66–2.34 mSv) for Scans 1 and 2, respectively ($p < 0.05$; Table 2). The scan length reduction of Scan 2 corresponded to a possible radiation dose reduction of 0.25 mSv for Scan 2 on the assumption of the same scan length as for planning Scan 1.

In the 30 patients, 247 coronary segments were analysed in both scans, corresponding to a total of 494 segments (9 central segments: pRCA, mRCA, dRCA, LM, pLAD, mLAD, pLCX, OM1, respectively, mLCX, RIM). Image quality scores were significantly better for Scan 2 [median, 3; interquartile range (IQR), 2–3] than for Scan 1 (median, 2; IQR, 1–3; $p < 0.05$; Table 3). Quality scores were identical for 96 segments, at least one point higher in Scan 2 for 147 segments, and at least one point higher in Scan 1 for 4 segments. 27 segments in the preliminary planning Scan 1 had a quality score of 0 precluding further diagnostic evaluation.

Stenoses were detected in 11 segments in Scan 2 (SOR) *vs* 15 in Scan 1. Of the 11 segments with a stenosis, 9 segments (true positive) were already recognized as stenotic in Scan 1 (planning scan), whereas 2 segments with stenoses were not identified as stenotic in Scan 1 (false negative, Table 4). In addition, there were six segments seen as stenotic in planning Scan 1 that were not stenotic in Scan 2 (false positive). Therefore, in the total population, the segment-based analysis yielded 0.82 sensitivity (95% CI, 0.51–0.95) and 0.97 specificity (95%, CI 0.93–0.99) for stenosis detection for planning Scan 1. The positive-predictive value was 0.60 (95% CI, 0.31–0.83) and the negative-predictive value was 0.99 (95% CI, 0.97–1.00). In the 11 stenotic segments, the quality score was identical for 5 segments and at least 1 point higher in Scan 2 for 6 segments. On a patient-based analysis, the 11 stenotic segments were found in 6 patients in Scan 2. In five (83%) of these patients at least one stenosis was already detectable in Scan 1. Hence, 24 patients had no stenosis in Scan 2. In 13 (54%) of these patients, the planning Scan 1 would have been

Figure 3. A patient with a stenosis in the proximal left main coronary artery. Scan 1 (a) was suitable to ensure a true-positive detection of the stenosis [confirmed in Scan 2, (b), arrows] with adequate diagnostic confidence, although quality scoring for Scan 1 was rated lower in this segment.



sufficient to exclude stenosis in all 9 segments analysed. On the other hand, in 10 (42%) of these patients, at least 1 coronary segment had inadequate image quality precluding diagnosis. Overall, planning Scan 1 was able to correctly identify or to exclude a coronary artery stenosis correctly in 18 (60%) of the 30 patients. On a per-patient basis, the prospective predictive value of Scan 1 was 83% (5 of 6 patients), and in patients with adequate image quality of all 9 segments analysed the negative-predictive value of Scan 1 was 100% (13 of 13 patients). Typical cases are provided in Figures 2–4.

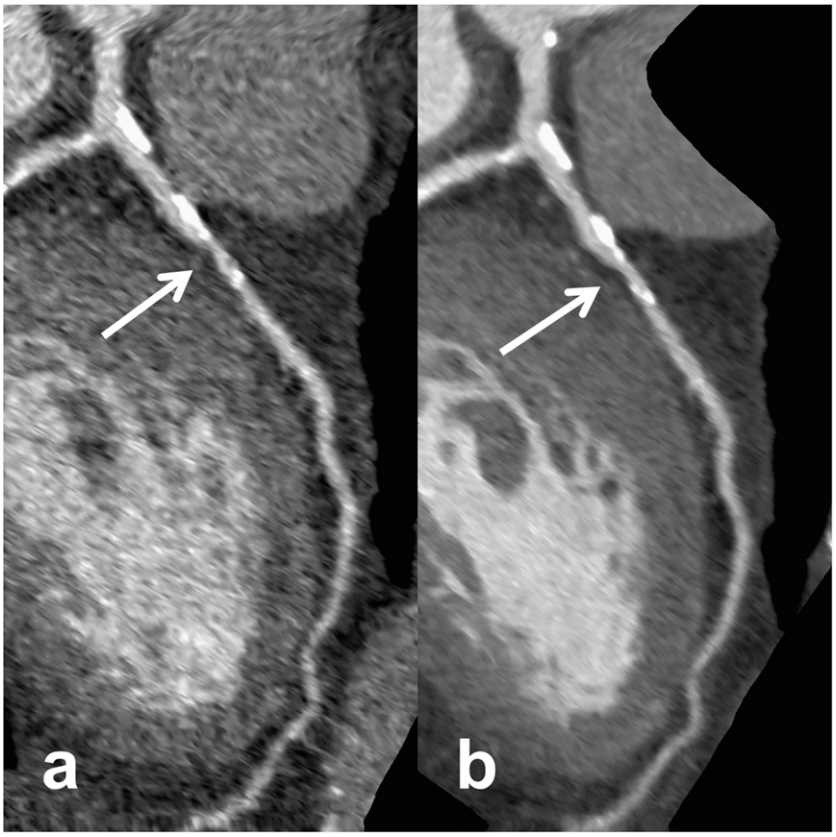
DISCUSSION

The results of our study indicate that an initial CTCA planning scan acquired with a very low dose allows a significant reduction of the length and the radiation dose of the subsequent standard CTCA scan by an average of 17%. Moreover, our findings suggest that the strategy presented here has the potential for a further considerable reduction of the radiation exposure associated with CTCA since the initial ultra-low-dose scan already revealed >80% of the stenotic segments. Even more important, on a patient basis and also considering examinations with non-evaluable segments, the ultra-low-dose planning Scan 1 was able to rule out stenosis in >50% (13/24) of the patients' non-stenotic coronary arteries.

The as low as reasonably achievable principle applies to any medical imaging test and means that the expected benefit must be achieved with the lowest possible radiation exposure that still ensures adequate diagnostic accuracy for the intended diagnostic purpose. In accordance with this principle, all technical developments in cardiac CT therefore had a two-fold aim: to improve diagnostic accuracy while at the same time also reducing radiation exposure by using techniques such as tube current modulation based on ECG recording,[15] prospective ECG gating[16] or modulation according to biometric patient characteristics (BMI, chest diameter).[17,18] In our study, an automatic online exposure control by means of the Care Dose 4D software tool based on the initial radiogram was used. The most recent techniques such as dual-source CT with high pitch or with a wide-area detector system, which scan the coronary artery system in a single heartbeat, have also led to a massive reduction of radiation exposure.[19,20]

The lower radiation exposure achieved with all of these techniques can be reduced even further by shortening the scan length. The benefit of using a prior calcium score scan for delimiting the range of CTCA scans has been explored by Gopal and Budoff.[11] Based on a calcium scan, Leschka et al[12] significantly reduced the length of subsequent dual-source CTCA by 22 mm from an average of 139–117 mm. Our results indicate that a significant reduction in scan length of CTCA can also be accomplished on the basis of a prior planning scan, which can be acquired with an ultra-low dose. We achieved exactly the

Figure 4. False-positive result of a suspected stenosis in the proximal left anterior descending coronary artery. Scan 1 (a) supposes a stenosis in a short section of the proximal left main coronary artery (arrow). However, Scan 2 (b) showed no stenosis in this segment (arrow).



same average significant scan length reduction of 22 mm (from 127 to 105 mm) for planning the range of the diagnostic scan using Scan 1 for orientation. With this strategy, adding 1 cm above the origin of the left coronary artery from the ascending aorta and 1 cm below the apex of the heart resulted in complete scans of the coronary system in all patients in our study. A further reduction of the length of the diagnostic scan, whether based on our method or on a prior calcium-scoring scan, is discouraged in order not to increase the risk of incomplete visualization. Some safety margin is necessary to make allowance for differences in inspiration depths between the planning scan and the diagnostic scan.[12] Therefore, it is very important to make sure that patients carefully follow breathing instructions and breath in evenly during both scans.

Using an initial calcium scan for reducing the scan length, Gopal and Budoff[11] achieved an average radiation exposure reduction of 22% in a population of 100 patients, and Leschka et al[12] reduced radiation exposure by 16% (1.7 mSv). We were aware of these results when choosing to use only one-fifth of the tube current suggested for standard Scan 2 in planning Scan 1 because it would be possible "to invest" about 20% of the dose of the shortened Scan 2 for Scan 1. However, one also has to take the radiation exposure of the initial scan into account, which is about 0.8 mSv on average for a calcium scan but only 0.27 mSv for the planning scan used in our study. If the length of the second standard scan had not been reduced, an average exposure of 1.43 mSv per scan would have resulted. This corresponds to a 20% reduction of the effective dose accomplished with use of an ultra-low-dose planning scan for reducing the length of the subsequent standard scan. In absolute terms, the dose reduction potential of 0.25 mSv is virtually the same as the additional exposure resulting from acquisition of the planning scan (0.27 mSv). Furthermore, the advantage of our method over the use of a calcium scan for scan length reduction lies in the additional diagnostic information this scan provides, which has considerable potential for further dose reduction in the study population as a whole. The initial planning scan showed stenosis in 5 of 6 patients with adequate diagnostic quality and was able to rule out stenosis in 13 of 24 patients. This means that the initial ultra-low-dose CTCA planning scan would have provided adequate diagnostic information at the per-patient level in 18 of 30 (60%) cases. In these patients, the subsequent standard CTCA scan may have been unnecessary, corresponding to a 50% dose reduction in the total study population. In this way, an average radiation exposure of approximately 0.7 mSv per patient would have been sufficient to make an assessment regarding the presence of stenosis in the coronary artery segments amenable to diagnostic interventions. One might discuss about our choice to use a fifth of the dose suggested by the exposure control software for planning Scan 1. Indeed, we were surprised by the result that even a fifth of the dose can still rule out stenoses in the nine central vessel segments in >50% of our patients correctly. The variation of the radiation dose of the initial planning scan might

be a topic for further studies. However, in retrospect, we feel that one-fifth of the dose was a good choice after all. It was not expected to rule out or find stenoses in all patients already with planning Scan 1, but it was supposed that a further radiation dose reduction would significantly increase the number of non-evaluable segments. Considering the results on a patient basis, this would probably lower the number of patients with a correct prediction significantly and would lead to an inconclusive result.

The study has a few limitations. It was performed in a single centre and included a limited number of 30 patients. Data on the image quality and the evaluation of stenoses were acquired in a consensus reading, which did not allow to test interobserver agreement. Nevertheless, this was a feasibility study primarily performed to prove the value of a preliminary ultra-low-dose planning scan. The interobserver agreement and the dose reduction potential of an ultra-low-dose initial scan that was shown here need to be confirmed in larger studies. Another limitation is that only patients with heart rates ≤65 beats per minute were included. However, this is a general limitation of dual-source CT with high pitch, which does not use overlapping acquisition and hence may result in non-diagnostic scans. Wang et al[21] have recently shown that high-pitch dual-source CTCA can also be used in patients with atrial fibrillation acquiring a double scan after a single contrast medium administration. The need for two contrast medium doses may be considered another limitation. However, as shown recently, high-pitch CTCA can be performed with low volumes of contrast medium.[22] Even with two contrast medium administrations, the body-weight-adjusted dose of approximately 40–50 ml in our study is on a similar order as the amount of contrast medium needed for a CTCA examination with prospective ECG gating over several heartbeats. Finally, the imaging approach evaluated in this study is very demanding for the personnel within an imaging department. In contrast to various types of CT examinations, a well-trained technician has to be available to perform the scans as well as a specialized radiologist who conducts a quick evaluation of the preliminary scan and who makes a decision on the further imaging strategy. Therefore, our technique appears especially suitable for centres with a high number of cardiac CT examinations where a radiologist specialized in cardiac imaging has to be present anyway.

CONCLUSION

An ultra-low-dose dual-source CTCA scan with high pitch is an effective approach for reducing the scan length of subsequent diagnostic CTCA scans. Moreover, this preliminary scan provides diagnostic information and hence can reduce further radiation exposure in part of the patients in the case that it already rules out a coronary artery stenosis.

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