Peer Review File

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Reviewer A

GENERAL COMMENTS

The original research article submitted by Ma et al. focuses on image quality (subjective and objective) and radiation dose comparing four different scanning protocols using a contemporary CT system with single heart-beat acquisition capability. The article deals with a current topic of interest in cardiac imaging, as CT is the central imaging method for preprocedural evaluation of patients being candidates for TAVR, once the diagnosis of severe aortic stenosis has been established by echocardiography. The clinical relevance of low-dose protocols for TAVR-CT is obvious, because 1) the absolute number of patients undergoing CT evaluation prior TAVR worldwide per year is growing, and 2) because TAVR is increasingly performed in younger patients with intermediate or low surgical risk profiles. Therefore, radiation dose and image quality are important.

The article is well structured, but has linguistic limitations that need to be addressed. A final native language correction is recommendable. There are further specific comments below that I would like to point out below in detail.

SPECIFIC COMMENTS

Title:

Not all of the protocols use low-kilovoltage and prospective ECG triggering. Therefore the title is misleading and should be modified accordingly.

Reply:

We have revised the title of the article.

Changes in the text:

Feasibility study of using low-kilovoltage, prospective gating, high-pitch, dual-source computed tomography prior transcatheter aortic valve replacement: analysis of image quality and radiation dose

Introduction:

Ok.

Reply: Thanks.

Material and methods

I would suggest to include coronary artery assessment in the article, because I believe it is interlinked with state-of-the-art TAVR-CT. If this is not part of the analysis, this can be discussed, but it should be omitted from conclusions!

Reply:

We have added explanations in the subjective evaluation of image quality.Due to the fact that the CT value evaluation of coronary arteries usually measures the CT value at the coronary artery opening, we have included the CT value measurement at the left and right coronary artery openings, as well as CNR measurements in the objective evaluation.

Changes in the text:

Two experienced radiologists (10 and 8 years of experience) scored the image quality of aorta and coronary arteries using the double-blind method according to the following scale

Objective evaluation included the measurement of left and right coronary artery, the aortic root, ascending aorta (approximately 3.5 cm from the aortic valve annulus), aortic arch, thoracic aorta (on same plane as the aortic valve annulus), renal artery-level abdominal aorta, and femoral arteries on both sides being set as the area of interest. The size of the area of interest of the ascending aortic root, aortic arch, thoracic aorta, and abdominal aorta was 100±5 mm^2; The target in left coronary artery, right coronary artery and the bilateral femoral arteries were approximately two-thirds of the lumen of the measurement level for the area of interest. Measurements were averaged over 3 consecutive levels to avoid plaque formation.

Indicator	Group A	Group B	Group C	Group D
CT value (HU)				
Aortic root	420.51±64.62	418.92±50.36	437.44±51.19	420.94±40.86
Left coronary artery	423.17±65.06	421.09±58.62	444.49±55.09	423.76±45.56
Right coronary artery	417.71±63.41	419.72±57.96	443.08±50.48	423.43±44.62
Ascending	431.84±64.86	440.34±46.50	433.58±51.53	437.84±42.34

CNR				
Aortic root	46.22±6.38	46.39±9.16	45.79±7.70	47.14±9.27
Left coronary artery	46.40±6.72	45.74±7.96	45.90±7.62	46.24±7.87
Right coronary artery	46.22±6.38	46.39±9.16	45.79±7.70	47.14±9.27

Discussion

Discussion on CT premedication (i.e. betablockers and nitroglycerine) may be included, considering pertinent references (e.g. Michail M et al. Feasibility and Validity of Computed Tomography-Derived Fractional Flow Reserve in Patients With Severe Aortic Stenosis: The CAST-FFR Study. Circ Cardiovasc Interv. Jan 2021;14(1):e009586. doi:10.1161/CIRCINTERVENTIONS.120.009586).

Discussion of coronary artery evaluation using TAVR-CT should be further discussed, considering pertinent references (e.g. Renker M et al. Combined CT Coronary Artery Assessment and TAVI Planning. Diagnostics (Basel). 2023 Apr 3;13(7):1327. doi: 10.3390/diagnostics13071327. AND Gatti M et al. Diagnostic accuracy of coronary computed tomography angiography for the evaluation of obstructive coronary artery disease in patients referred for transcatheter aortic valve implantation: a systematic review and meta-analysis. Eur Radiol. 2022 Aug;32(8):5189-5200. doi: 10.1007/s00330-022-08603-y.).

If coronary artery assessment is not part of the analysis, I strongly suggest to omit it from the conslusions.

Reply:

Thanks. We have made the modifications according to the above suggestions. We have removed some content and added discussion content related to CT-FRR.

Changes in the text :

In addition, coronary CTA combined with CT-FFR can reduce unnecessary coronary angiography before TAVR surgery (13,14). The use of beta blockers and nitroglycerin before examination to calculate the CT-FFR can improve the diagnostic accuracy (15).

13.Renker M, Schoepf UJ, Kim WK. Combined CT Coronary Artery Assessment and TAVI Planning. Diagnostics (Basel). 2023;13(7):1327. Published 2023 Apr 3.

14.Gatti M, Gallone G, Poggi V, et al. Diagnostic accuracy of coronary computed tomography angiography for the evaluation of obstructive coronary artery disease in patients referred for transcatheter aortic valve implantation: a systematic review and meta-analysis. Eur Radiol. 2022;32(8):5189-5200.

15.Michail M, Ihdayhid AR, Comella A, et al. Feasibility and Validity of Computed Tomography-Derived Fractional Flow Reserve in Patients With Severe Aortic Stenosis: The CAST-FFR Study. Circ Cardiovasc Interv. 2021;14(1):e009586.

References

Please see suggestions above.

Reply:

Thanks. We have made the modifications according to the above suggestions. As shown above.

Tables

Presentation of results in tables 3 and 4 can be improved. I would suggest to add p-values to all result rows, the indication of results with statistical significance can be kept.

Reply:

Thank you, we have made the modifications.

Changes in the text :

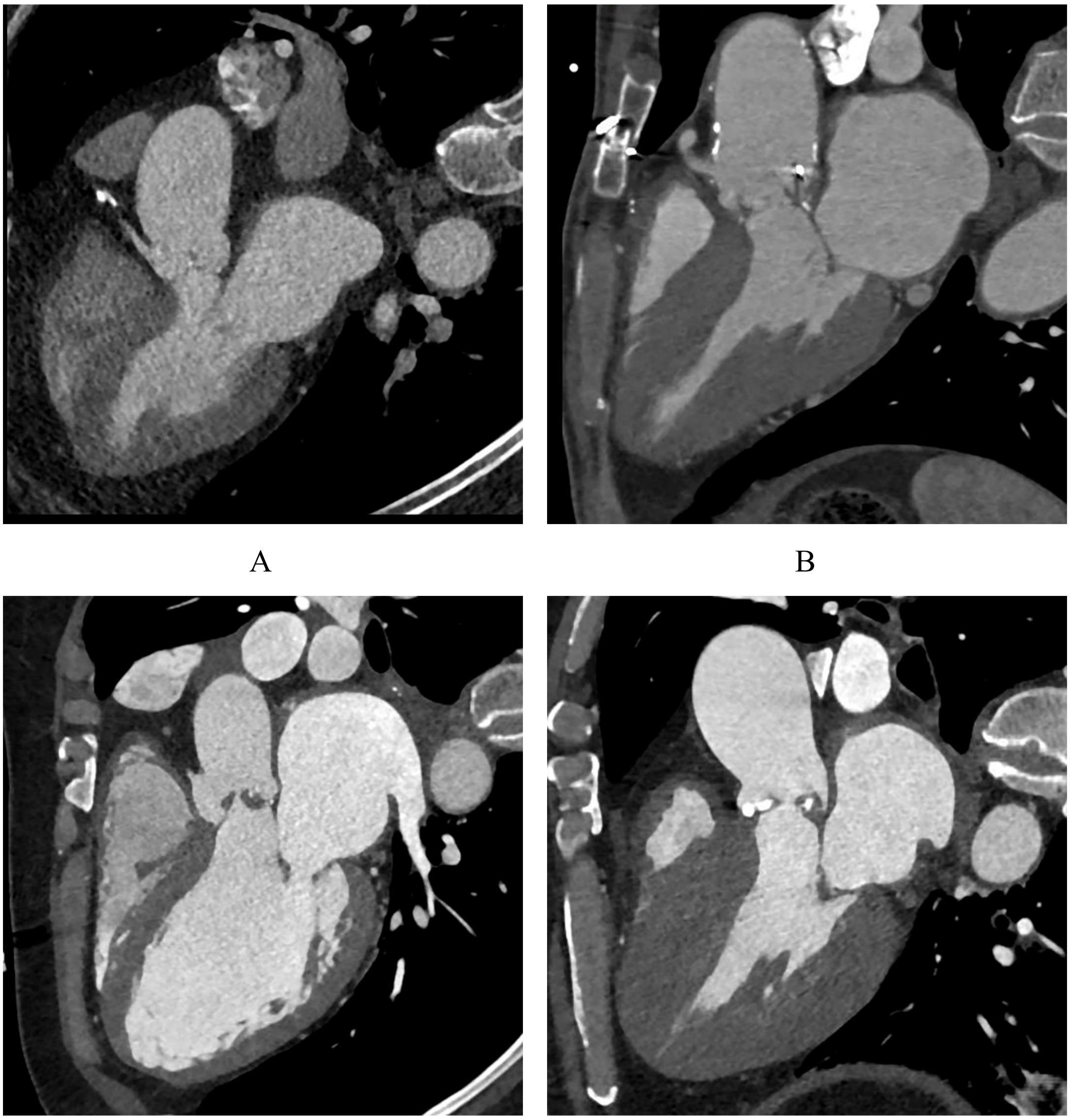
Table 3 Subjective evaluation of image quality

Score	Group A, n (%)	Group B, n (%)	Group C, n (%)	Group D, n (%)
4	36 (60.00)	33 (55.00)	38 (63.33)	39 (65.00)
3	16 (26.67)	18 (30.00)	16(26.67)	13(21.67)
2	6(10.00)	8 (13.33)	4(6.67)	6 (10.00)
1	2(3.33)	1(1.67)	2(3.33)	2 (3.33)

The use of the kappa test: χ^2=3.147，P=0.963.

Figures

One more figure demonstrating the different protocols should be considered.
Reply:
Thanks. We have made the modifications.
Changes in the text:



A B

C D

Figure 2 A-D show reconstructed images of the left ventricular outflow tract and aortic valve in the A-D group. Among the four images, the image noise in Figure A is relatively high, but it does not affect the evaluation of the valve.

Reviewer B

Thank you for your interesting manuscript. I must admit that the topic and selection of protocols was very interesting. Therefore in my opinion the article should be resubmitted after through proof-reading session. Moreover, I have some more specific comments:

General remarks:

1. The Introduction and Discussion sections are currently quite brief and contain a limited number of citations. Furthermore, they need to be restructured. In my opinion, a more detailed introduction and a thorough description of the dual-energy acquisition method employed would enhance the introductory section. The discussion could be improved with a more extensive explanation of potential radiation dose reductions in vascular studies during DECT (Dual-Energy Computed Tomography) examinations. For instance, the virtual non-contrast phase could be further elaborated upon:

https://doi.org/10.1016/j.acra.2023.03.018,

https://doi.org/10.3390/app13127134

Reply 1:

Thanks. We have made the modifications.

Changes in the text :

The dual-energy acquisition method can also reduce radiation dose in vascular scanning (21). This method can be used for virtual plain scanning to diagnose cardiovascular diseases, reducing radiation dose and contrast agents (22).

21. Kazimierczak W, Kazimierczak N, Lemanowicz A, et al. Improved Detection of Endoleaks in Virtual Monoenergetic Images in Dual-Energy CT Angiography Following EVAR. Acad Radiol. 2023;30(12):2813-2824.

22. Floridi C, Cacioppa LM, Agliata G, et al. True Non-Contrast Phase versus Virtual-Non Contrast: "Lights and Shadows" of Dual Energy CT Angiography in Peripheral Arterial Disease. Applied Sciences. 2023; 13(12):7134.

2. Figure 1 is too big and provides unnecessary images.

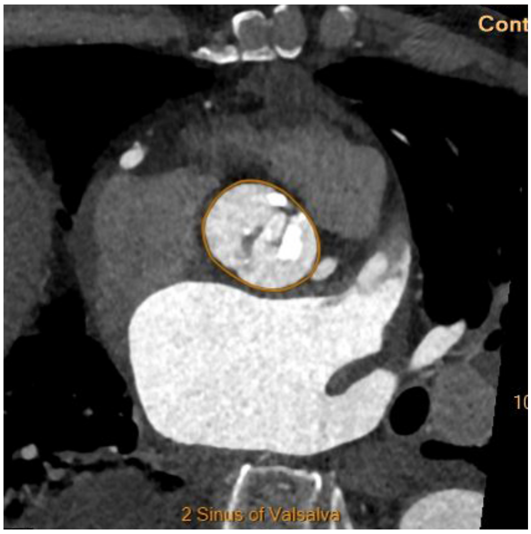
Reply 2:

Thanks. We have made the modifications.

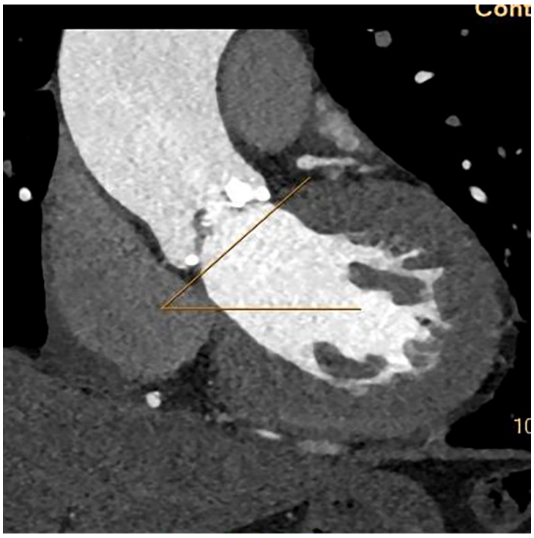
Changes in the text:


Contra
10 c
1 Annulus

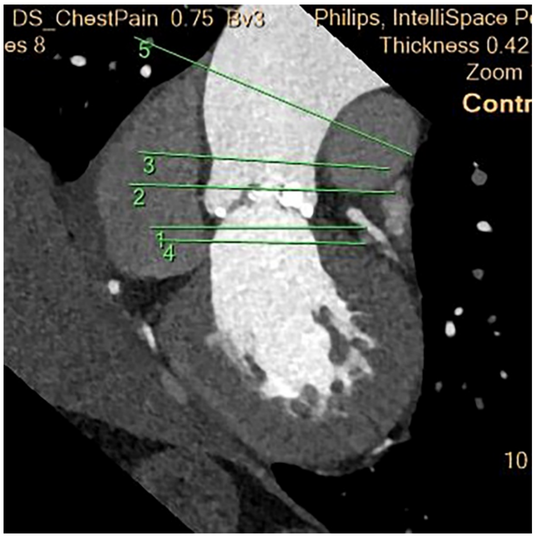
A


Cont
10
2 Sinus of Valsalva

B


Cont
10

C


DS_ChestPain 0.75 Bv3
Philips, IntelliSpace P
es 8
Thickness 0.42
Zoom
Contr
5
3
2
1
4
10

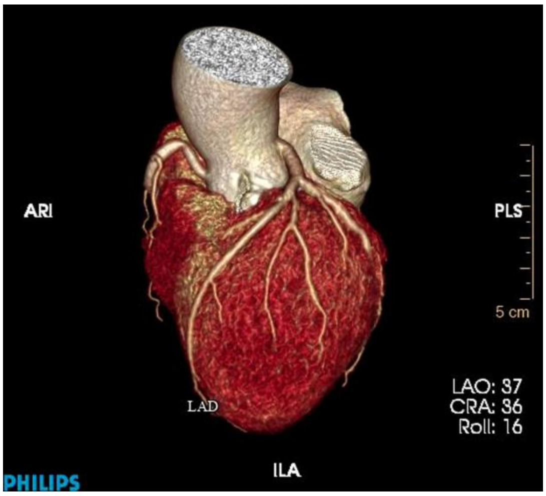
D


F

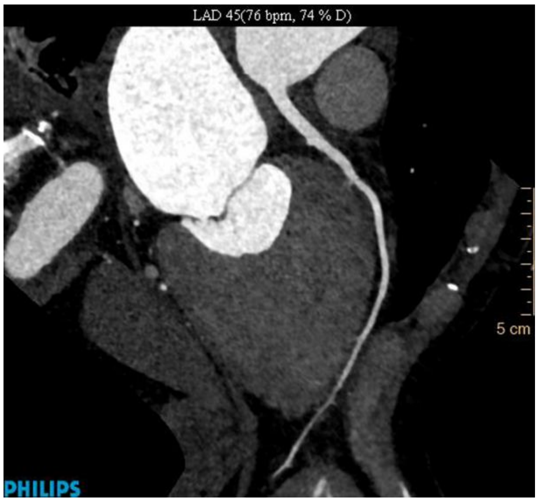
E


A
30 cm
Aorta and Right Iliac
PHILIPS

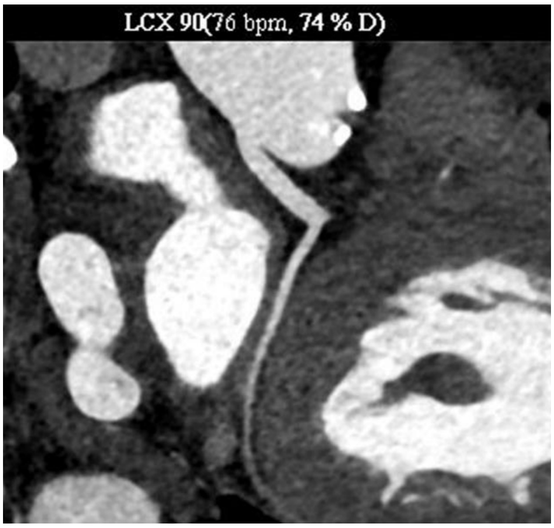
F


ARI
PLS
5 cm
LAD
LAO: 37
CRA: 36
Roll: 16
ILA
PHILIPS

G


LAD 45(76 bpm, 74 % D)
5 cm
PHILIPS

H



I

J

3. Graph presenting the differences in CNR and SNR levels would be very useful.

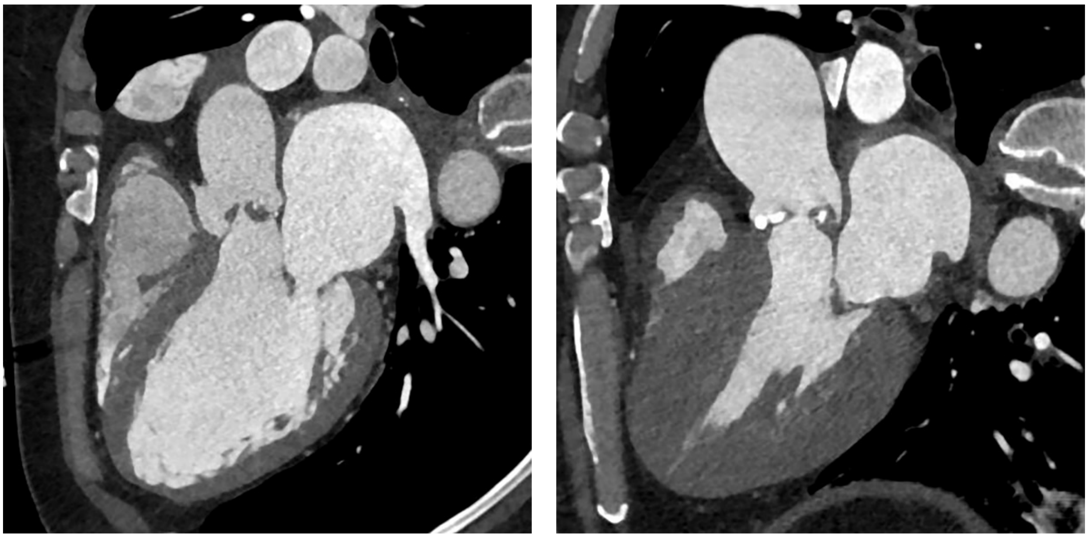
Reply 3:

Thanks. We have made the modifications.

Changes in the text:

A

B



C D

Figure 2 A-D show reconstructed images of the left ventricular outflow tract and aortic valve in the A-D group. Among the four images, the image noise in Figure A is relatively high, but it does not affect the evaluation of the valve.

4. All abbreviations used in the tables should be expanded below the tables.

I have prepared some detailed comments; however, the manuscript needs to be thoroughly revised before resubmitting.

1. Pleas clarify the I sentence of the manuscript.
2. Lines 73-76 – provide the guidelines citation.
3. Sentence" most preoperative MDCT examinations for TAVR are performed using a combined scanning protocol, in which both the heart (aortic valve) and the aorta (iliac and femoral arteries) …" is unclear and it makes the impression that, the femoral arteries are the parts of aorta.
4. Remove the sentence: "There is a concern for contrast-induced nephropathy (CIN) in these patients with underlying renal dysfunction." As it is not related to the purpose of the study, no citation is provided, and such a brief statement is not connected in any way to the goal of the research and does not contribute quality to the introduction. Consequently, since the research is associated with the reduction of radiation dosage, the introduction should more comprehensively describe the topic of radiation protection.

Reply 4:

Thanks. We have made the modifications.

Changes in the text :

ECG-gate	Prospective	Retrospective	Prospective	Prospective
Phase range (R-R interval) (%)	20–90	0–100	20–90	20–90
Slice thickness (mm)	0.75	0.75	0.75	0.75
Kernel	Br44	Br44	Br44	Br44

kV，kilovoltage; ECG, electrocardiography; Rot., rotation.

4.1

Transcatheter aortic valve replacement (TAVR) is an efficacious procedure for patients with severe aortic stenosis who are at a high risk of surgical aortic valve replacement, even in moderate or low-risk populations of aortic stenosis(1,2,3). To ensure the success

4.2

and reduce the complications of surgery, it is important that accurate imaging evaluation be completed before TAVR procedure (4). Multidetector computed tomography (MDCT) scans are now commonly used to size the prosthetic valve based on aortic annulus measurements, assess high risk factors and evaluate the access vessels for size, tortuosity and any other complications(4.5).

4.3

circumference increasing during systole (6). ~~most preoperative MDCT examinations for TAVR are performed using a combined scanning protocol, in which both the heart (aortic valve) and the aorta (iliac and femoral arteries) are evaluated in a single examination, which inevitably increases the radiation dose and the amount of contrast.~~Most preoperative MDCT examinations of TAVR are performed using a combined scanning protocol, with the coronary artery, aortic valve, and entire aorta (including iliac and femoral arteries) evaluated in one examination, which inevitably increasing the radiation dose and amount of contrast.~~There is a concern for contrast-~~

Most preoperative MDCT examinations of TAVR are performed using a combined scanning protocol, with the coronary artery, aortic valve, and entire aorta (including iliac and femoral arteries) evaluated in one examination, which inevitably increasing the radiation dose and amount of contrast.

4.4

contrast.~~There is a concern for contrast-induced nephropathy (CIN) in these patients with underlying renal dysfunction.~~ The purpose of our study was to evaluate the feasibility of preoperative low-radiation dose imaging with third-generation dual-

5. 164-172, clarification needed – the sentences are chaotically organized. Signal intensity = mean attenuation.

Reply 5:

Thanks. We have made the modifications.

Changes in the text :

CNR was calculated as follows: CNR = (the mean CT value of the target vessel − paraspinal muscle CT value)/ the standard deviation of the noise of the anterior thoracic air. Meanwhile, SNR was calculated as follows: SNR = the mean CT value of the target vessel/ the standard deviation of the noise of the anterior thoracic air.

6. Line 188 – p not "P".

Reply 6:

Thanks,We have made the modifications.

Changes in the text :

signal intensity, noise, SNR, and CNR of the 4 groups were analyzed with analysis of variance (ANOVA) and compared between the groups. Subjective scores for sex and image quality were tested using the kappa test. Differences were considered statistically significant at pP<0.05.

7. 204-205 – repeated words.

Reply 7:

Thanks. We have made the modifications

Changes in the text :

all of these have severe coronary artery tomography artifacts due to arrhythmia or coronary artery movement during patient scanning.

8. The mean radiation dose.

Reply 8:

Thanks. We have made the modifications. The average radiation dose used to represent the radiation dose for each group.

Changes in the text :

Results: There were no differences in age, body mass index (BMI), subjective image quality scores, computed tomography (CT) values between the aorta and the coronary artery, or image CNR between the 4 groups. The mean radiation doses of groups A–D were 4.13±0.69, 4.79±0.58, 12.00±1.62, and 15.01±1.90 mSv, respectively. The mean radiation dose in group A (70-kV prospective ECG gating) decreased significantly ($P<0.05$).

The DLP and ED of groups A and B with the 70-kV coronary artery scanning protocol were significantly lower than those of groups C and D, respectively. The mean radiation dose in group A was lower than that in group B ($P<0.05$). Relative to group C at 100 kV, the ED of groups A and B was reduced by approximately 65.58% and 60.08%, respectively.

9. Etc…

Thanks.

Reviewer C

1. Please check all abbreviations in the abstract, Highlight box and the main text, such as “DSCT, TAVR, CT, ECG" in Highlight box; “ECG, CT” in introduction. Abbreviated terms should be full when they first appear.

Reply:

Highlight box

Key findings

The low-kilovoltage, prospective gating, high-pitch scanning modes of dual-source computed tomography (DSCT)~~DSCT~~ can effectively reduce the radiation dose of patients. The image quality is comparable for the preoperative evaluation of ~~TAVR~~ transcatheter aortic valve replacement (TAVR).

What is known and what is new?

• It is necessary to perform ~~CT~~ computed tomography (CT) –scanning before TAVR surgery. Prospective electrocardiography (ECG)~~ECG~~ gating model have been used for CT scans of coronary arteries.

for size, tortuosity and any other complications(4.5).

MDCT scanning of the heart can be performed using nonc-gated and electrocardiography (ECG)~~ECG~~-gated scanning protocols, which can be subdivided into retrospective and prospective cardiac-gated scanning protocols. Retrospective ECG gating allows for the reconstruction of multiple cardiac cycles in time, ensuring a successful examination but with a higher radiation dose than in prospective ECG gating

2. Table 2

2.1 There seems to be no “*” in Table 2, while it was explained in the legend. Please check and revise.

2.2 Please indicate how the data are presented in Tables.

Reply:

Table 2 Comparison of general data

Index	Group A (n=60)	Group B (n=60)	Group C (n=60)	Group D (n=60)	P
Sex (male/female)	28/32	29/31	26/34	29/31	0.941*
Age (years)	79.40±5.08	80.60±6.43	80.10±5.39	80.40±4.84	0.814
Height (cm)	162.55±6.16	162.00±7.22	162.37±5.59	161.73±6.16	0.962
Weight (kg)	55.87±5.73	55.12±6.01	56.20±5.99	54.63±5.52	0.561
BMI (kg/m^2)	21.23±2.69	21.10±2.77	21.39±2.79	20.95±2.05	0.914

*, the use of the kappa test; χ^2=0.715; the remaining variables were analyzed using one-way analysis of variance. BMI, body mass index. Data are presented as mean ± standard deviation, or number (frequency).

Table 3 Subjective evaluation of image quality

Score	Group A, n (%)	Group B, n (%)	Group C, n (%)	Group D, n (%)
4	36 (60.00)	33 (55.00)	38 (63.33)	39 (65.00)
3	16 (26.67)	18 (30.00)	16(26.67)	13(21.67)
2	6(10.00)	8 (13.33)	4(6.67)	6 (10.00)
1	2(3.33)	1(1.67)	2(3.33)	2 (3.33)

The use of the kappa test: χ^2=3.147, P=0.963. Data are presented as N (%).

3. Table 4

Please indicate how the data are presented in Tables.

Reply:

ED (mSv)	4.13±0.69^{*BCD}	4.79±0.58^{*CD}	12.00±1.62^{*D}	15.01±1.90

*, P<0.05. CT, computed tomography; ^{B}, group B; ^{C}, group C; ^{D}, group D.; HU, Hounsfield unit; CNR, contrast-to-noise ratio; DLP, dose-length product; ED, effective dose. Data are presented as mean ± standard deviation.