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## LETTER TO THE EDITOR

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# Clinical Evaluation of Radiation Dose Benefit and Image Quality of the Step-and-Shoot Technique Electrocardiogram-gated Coronary Computed Tomography Angiography

Dear Sir,

I read the study by Lo et al<sup>1</sup> with great interest. I agree that it is important to minimise the radiation dose to patients for all radiological examinations, especially for those high-radiation dose examinations of coronary computed tomography angiogram (CCTA). However, I have some questions about the authors' findings.

Lo et al used a technique called SnapShot Pulse (SSP), which was said to be a new technique using a prospective electrocardiogram (ECG) trigger method.<sup>1</sup> Prospective ECG trigger cardiac imaging has been used for a long time, even before the era of 16- or 64-multislice CT. Nowadays, many centres still use this technique for calcium score examination. It is not difficult to understand that this technique is the most dose-efficient and results in the least radiation to the patient, as scanning is only performed in a small portion of the RR interval, as opposed to the continuous scanning with the retrospective gated method. However, despite this advantage, its use in contrast CCTA examination has been largely replaced by the retrospective gated method as the latter can generate a volumetric data set that can be used for good 3-dimensional volume rendering. Also, it is known that the best RR interval for visualisation of the 3 coronary arteries is different for each one. By using a retrospective method, images can be reconstructed retrospectively in any RR interval for better anatomical assessment, and also for functional analysis. So, I wonder whether the method described by the authors is any different from the traditional prospective method and can overcome these limitations. The authors concluded that this SSP method preserved the image quality but confers a beneficial radiation dose reduction. Will the authors advocate using this technique instead of the helical scan for all CCTA examinations? If not, how should patients be selected for the prospective or the retrospective methods?

Another query is on the test employed for statistical analysis. The authors used a subjective 4-point scoring system in their evaluation. This kind of arbitrary scoring system, like the Apgar score, Glasgow coma scale (GCS), clinical staging of a cancer, and visual analogue scales, should be categorised as an ordered categorical but not continuous data.<sup>2</sup> It would be meaningless or confusing to say that the mean GCS of the control group was 9.4 or recording the average stage of a cancer as 2.5. We cannot infer that an image with a score of 3 is 50% clearer than one with a score of 2 or 3 times better than that with a score of 1. The only information the numbers provide is in the ordering, which would be conveyed equally by calling them 'bad', 'fair', 'good', and 'excellent'. Moreover, as there were only 20 patients in each group, assumption of normal distribution of their data is probably invalid. Non-parametric methods based on rank ordering of the scores such as the Mann-Whitney test may be more appropriate than using a *t* test, which is only valid for continuous data with normal distribution.

## REFERENCES

1. Lo GG, Chan JK, Yu SK, Lau CW, Leung YF. Clinical evaluation of radiation dose benefit and image quality of the step-and-shoot technique electrocardiogram-gated coronary computed tomography angiography. *J HK Coll Radiol*. 2008;11:81-4.
2. Altman DG. *Practical statistics for medical research*. Norwell: Chapman and Hall; 1991. p 10-6.

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## COMMENT

Dear Sir,

We sincerely appreciate the interest from the readers of our paper.<sup>1</sup> The prospective electrocardiogram (ECG)-triggered cardiac imaging was not a new technique. With this old technique, the radiation is continuously delivered from the X-ray tube. A major improvement was made to trigger the X-ray output with the ECG so that radiation will only be turned on during a user-specified window within the RR interval. The new method is called the SnapShot Pulse (SSP; step-and-shoot) technique. This technique was first presented by Hsieh et al at the 2005 Radiological Society of North America meeting (Chicago, USA; 27 November to 2 December 2005) as a hot topic and later published in *Medical Physics*.<sup>2</sup> Therefore, the technique is still relatively new.

The SSP technique collects volumetric data for 3-dimensional volume rendering without any problem. It is known that the best window for visualisation of the 3 coronary arteries is different, and this is especially pronounced for patients with fast heart rates. However, the SSP technique is limited to patients with relatively stable heart rates of <65 bpm. At these low heart rates, there are no significant differences in visualisation using different windows for the 3 coronary arteries. We use the SSP technique only for patients with heart rates <65 bpm with or without  $\beta$ -blockers. For patients who

are unsuited to the new technique, we use the conventional ECG-gated mA modulated helical technique.

About the comment on the statistical analysis, we agree that it would be more appropriate to use the non-parametric method. However, the mean scores obtained from both ECG mA modulation and SSP techniques were high and comparable. This indicates that both techniques are capable of producing images of good diagnostic quality. Therefore, the conclusion of this study remains unchanged, in that the SSP technique can confer a beneficial radiation dose reduction while preserving high diagnostic image quality.

## REFERENCES

1. Lo GG, Chan JK, Yu SK, Lau CW, Leung YF. Clinical evaluation of radiation dose benefit and image quality of the step-and-shoot technique electrocardiogram-gated coronary computed tomography angiography. *J HK Coll Radiol*. 2008;11:81-4.
2. Hsieh J, Londt J, Vass M, Li J, Tang X, Okerlund D. Step-and-shoot data acquisition and reconstruction for cardiac X-ray computed tomography. *Med Phys*. 2006;33:4236-48.

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