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New Artificial Intelligence Algorithms in Coronary CT Angiography

SHORT ABSTRACT

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ABSTRACT

Artificial intelligence (AI) has been developed in coronary CT in many fields, such as image reconstruction, automatic calcium scoring calculation, cardio-vascular risk prediction, automatic image segmentation, automatic plaque quantification and now also image interpretation, including stenosis detection and ischemia prediction.

New AI algorithms might facilitate the use of Coronary CT from acquisition to interpretation. These tools should be soon be available for daily use.

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Artificial intelligence (AI) has been developed in coronary computed tomography (CT) in many fields, such as image reconstruction, automatic calcium scoring calculation, cardiovascular risk prediction, automatic image segmentation, automatic plaque quantification and more recently also image interpretation, including stenosis detection and ischemia prediction.

- Using algorithms based on deep learning algorithms, manufacturers may achieve better image quality, allowing either radiation dose reduction or improved spatial resolution (or both). AI can be applied also for mitigating motion artifacts due to cardiac movements.
- Calcium scoring (CAC) can be performed automatically by deep learning algorithms for risk prediction in unenhanced scans (gated or ungated). CAC can also be estimated directly from iodine enhanced coronary CT angiograms. CAC is currently a very strong predictor of future cardiovascular event.
- Plaque volume has also been shown as an excellent predictor of future cardiac event, using data from the SCOT-HEART study. Automatic assessment of cororonary plaque volume avoids a long post-processing time, not routinely performed in clinical routine.
- Periarterial fat inflammation is considered a promising early and fairly reliable marker of cardiac risk, more easily assessable with dedicated AI techniques.

Automatic segmentation for centerline extraction may be applied to overcome the substantial rate of inaccurate centerlines created with non-AI based algorithms, especially in case of calcified lesions. Automatic algorithms might contribute to a considerable reduction in medical time, reportedly up to 700 hours annually in centers with a high number of coronary CT studies. An example of automatic AI-based segmentation and image analysis is illustrated in Figure 1.

AI based on deep learning might provide automatic CAD-RADS classification. In an initial study, CorEx software reached 96% accuracy for ≥50% stenosis detection, without significant difference compared to an expert's readings. Automatic stenosis classification may change the workflow with prioritization of the cases. Indeed, in acute settings, most severe ranged cases could be read first to reduce a potential risk of irreversible ischemia. CorEx software has been evaluated in the emergency department (ED), with an opportunistic detection of all severe stenosis in acute coronary syndromes (not diagnosed initially in ED), in patients who underwent electrocardiogram (ECG) gated CT-angiography to rule out aorticdissection [1].

Beyond stenosis classification, fractional flow reserve (FFR)-AI prediction has been studied with a new the deep learning model, using FFR measurements obtained in the cathlab as a ground truth. The accuracy of the FFR-AI model reached 85%, with a negative predictive value at 96%, (Peters B et al., submitted) enabling to reduce a considerable number of invasive coronary angiographies, with a fast (less than 1 minute!) point-of-care solution.

In conclusion, new AI algorithms seem to facilitate the use of coronary CT from acquisition to interpretation. These tools should be available in the near future for routine in clinical practice.

COMPETING INTERESTS

Jean-Francois Paul is founder of Spimed-AI.

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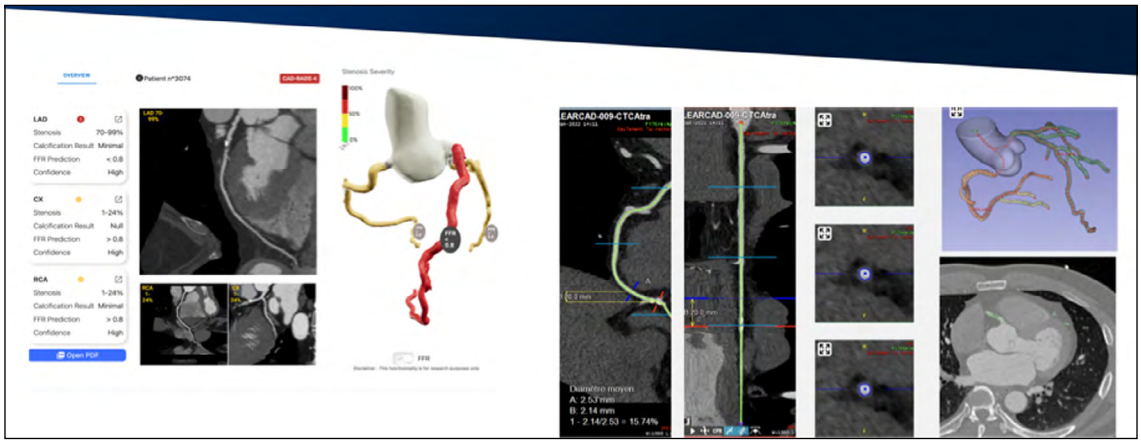

Figure 1 Example of AI automatic segmentation for stenosis classification and FFR prediction with CorEx software.

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