Fully Automated Artificial Intelligence-based Coronary Artery Disease Diagnosis from SPECT Myocardial Perfusion Imaging

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Purpose
While the gold standard method for the diagnosis of obstructive coronary artery disease (CAD) is invasive coronary angiography (ICA), SPECT myocardial perfusion imaging (MPI) has diagnostic value in the assessment of CAD. As such, it is conventionally used as a non-invasive tool for pre-ICA-diagnosis. In this study, we developed a robust automated diagnosis method of obstructive CAD from SPECT-MPI polar maps using deep learning (DL).

Methods and Materials
A total of 940 patients who underwent SPECT-MPI were enrolled, of which 281 were accompanied with ICA (#1), and 659 without ICA (#2). In #2, patients with a sum score >=4 (based on nuclear medicine physician (NMP) report) were considered abnormal. Three different scenarios (SCs) were pursued; 1) using only #1 for training/validation and testing the models; 2) adding #2 to the training cohort only; 3) using both datasets but only using the NMPs report as ground truth. Both stress and rest polar maps were used as input for the models. DensNet201 network with spatial pyramid pooling (SPP) aggregation model was utilized. We evaluated our models for the left anterior artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA).

Results
The following results are obtained for LAD, RCA, and LCX, respectively. In the SC1, an AUC of [0.61, 0.62, 0.69], sensitivity (SEN) of [0.70, 0.72, 0.88], and specificity (SPE) of [0.42, 0.49, 0.47] were achieved. In the SC2, AUC was [0.60, 0.63, 0.71], SEN was [0.72, 0.59, 0.58], and SPE was [0.53, 0.62, 0.74]. In the SC3, AUC was [0.87, 0.90, 0.92], SEN was [0.93, 0.83, 0.85], and SPE was [0.73, 0.78, 0.82].

Conclusion
Overall, the results for all SCs were superior for LCX. The SC2 did not improve SEN but enhanced SPE. The SC3 showed outstanding outcomes. This study demonstrated the potential of SPECT-MPI for predicting ICA diagnosis. The use of an expanded dataset might improve the performance of the model.