Automated Detection of Coronary Artery Disease from Multiparametric Cardiac Magnetic Resonance Imaging Using Deep Learning

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Abstract

Coronary artery disease (CAD) remains the most prevalent cardiovascular disorder and a leading cause of global morbidity and mortality. It is primarily driven by atherosclerotic plaque accumulation within the coronary arteries, resulting in impaired myocardial perfusion and potentially leading to ischemia, myocardial infarction, or sudden cardiac death. This study aimed to evaluate the performance of two deep convolutional neural network (CNN) architectures (DenseNet121 and ResNet50) for automated detection of CAD using multiparametric cardiac magnetic resonance (CMR) imaging. Model validation was performed using multiparametric CMR datasets (cine, T1 mapping, T2 mapping, and late gadolinium enhancement sequences) used as input for all training and evaluation procedures. Performance was assessed using a rigorous evaluation protocol consisting of 50 independent runs of 10 fold cross validation. Evaluation metrics included average classification accuracy (ACA), area under the receiver operating characteristic curve (AUC ROC), precision–recall AUC (PR AUC), and performance variability quantified by standard deviation. ResNet50 demonstrated superior performance and greater stability compared with DenseNet121, achieving an ACA of 92% (95% CI: 91–93%), an AUC ROC of 0.96 (95% CI: 0.95–0.97), and a PR AUC of 0.89 (95% CI: 0.87–0.91). In contrast, DenseNet121 achieved an ACA of 80% (95% CI: 78–82%) and an AUC ROC of 0.89 (95% CI: 0.87–0.91). These results indicate that ResNet50 consistently outperformed DenseNet121 across all validation metrics, with narrower confidence intervals reflecting greater robustness and reduced performance variability. The findings support the use of ResNet50 as a more reliable architecture for CAD detection from multiparametric CMR data. Given the clinical importance of early and accurate CAD identification—particularly for guiding timely intervention and risk stratification—these results highlight the potential of well validated deep learning models to enhance diagnostic workflows and support clinical decision making in cardiovascular imaging.

Keywords: Coronary artery disease; Cardiac Magnetic Resonance (CMR); Deep learning; ResNet50