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Radiomics in Coronary CT Angiography for Assessing Vulnerable Coronary Artery Plaques: A Systematic Review

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Case Study

Coronary artery disease remains a leading cause of morbidity and mortality worldwide. Identifying vulnerable plaques those prone to rupture and cause acute coronary events—is crucial for improving patient outcomes. Coronary CT angiography has emerged as a non-invasive imaging modality for visualizing coronary arteries and detecting atherosclerotic plaques. Recent advances in radiomics, which involve extracting and analyzing quantitative features from medical images, offer a promising approach for characterizing plaque vulnerability. Radiomics leverages machine learning algorithms and computational models to analyze high-dimensional data, identifying patterns and associations that may not be discernible to the human eye. Studies have explored the use of CCTA-based radiomics to assess features such as plaque composition, morphology, and hemodynamic significance. Key radiomic parameters, including texture, shape, and intensity, have been linked to biological markers of plaque instability, such as necrotic core, thin fibrous cap, and positive remodeling.

Systematic reviews of the current literature indicate that radiomics can enhance the diagnostic performance of CCTA, providing insights into plaque vulnerability beyond traditional visual assessment. Radiomic models have demonstrated high sensitivity and specificity in differentiating stable from unstable plaques, making them valuable tools for risk stratification. However, challenges remain in terms of standardizing feature extraction, validation across diverse populations, and integrating radiomics into clinical workflows. The growing interest in CCTA-based radiomics underscores its potential as a precision medicine tool for CAD management. By enabling early detection of high-risk plaques, radiomics could facilitate targeted interventions and personalized treatment strategies. Future research should focus on large-scale, multicenter studies to validate radiomic signatures and explore their integration with other diagnostic modalities and clinical data, ultimately advancing CAD diagnosis and prevention [1,2].

Keywords: Cardiac imaging; Plaque rupture; Radiomics features

Acknowledgement

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Conflict of Interest

None.

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