Diagnosis of coronary layered plaque by deep learning

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Background/Introduction: Healed coronary plaques, morphologically characterized by a layered pattern, are signatures of previous plaque disruption and healing. Recent optical coherence tomography (OCT) studies showed that layered plaque is associated with vascular vulnerability and rapid plaque progression. However, the diagnosis of layered plaque requires expertise in OCT image interpretation and is susceptible to interobserver variability.

Purpose: We aimed to develop a deep learning (DL) model for an accurate diagnosis of layered plaque.

Methods: We developed a Visual Transformer (ViT)-based DL model emulating the cardiologists who review consecutive OCT frames to make a diagnosis (Figure 1), and compared it to the standard convolutional neural network (CNN) model. We used 302,415 cross-sectional OCT images from 873 patients collected from 9 sites: 237,021 images from 581 patients for training and internal validation from 8 sites, and 65,394 images from 292 patients collected from another site for external validation.

Results: Model performances were evaluated using the area under the receiver operating characteristics (AUC). In the five-fold cross validation, the ViT-based model showed better performance than the standard CNN-based model with AUC of 0.886 (95% confidence interval [CI], 0.882–0.891) compared with 0.797 (95% CI, 0.790–0.804). The ViT-based model also outperformed the standard CNN-based model in the external validation, with an AUC of 0.857 (95% CI, 0.849–0.864) compared to 0.806 (95% CI, 0.797–0.815) (Figure 2).

Conclusion(s): The ViT-based DL model will help cardiologists to make an accurate diagnosis of layered plaque, which might help to stratify the risk of future adverse cardiac events.

Figure 1. Description of proposed method

Figure 2. Diagnostic performances