Residual-attention Deep Learning Model for Atrial Fibrillation Detection from Holter Recordings

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Abstract

Background: Detecting subtle patterns of atrial fibrillation (AF) and irregularities in Holter recordings is intricate and unscalable if done manually. Artificial intelligence-based techniques can be beneficial. In fact, with the rapid advancement of AI, deep learning (DL) demonstrated the capability to identify AF from ECGs with significant performance. However, further development and validation on larger cohorts is still needed.

Purpose: The main purpose of this study was to develop a Residual-attention DL model by considering a large cohort of 2-lead Holter recordings.

Methods: We developed a residual DL model by collecting a large dataset of 661 Holter recordings, which was labelled manually by an expert cardiologist. The DL model leveraged attention mechanisms, allowing it to capture long-range dependencies and intricate temporal relationships crucial for identifying subtle patterns indicative of AF.

Results: Experimental results demonstrated that our model achieved a sensitivity (detection of AF) of Se = 0.928 and a specificity of Se = 0.915, with an AUC-ROC of AUC = 0.967 on our dataset. Additionally, when evaluated with an external test dataset, specifically IRIDIA- AF, our DL model obtained Se = 0.942, Sp = 0.932, and AUC = 0.965. Finally, when compared under similar experimental conditions with other state-of-the-art models, our DL model achieved slightly better performance overall.

Conclusion: The Residual-attention DL model we proposed offers a promising solution for AF detection. The validation on external datasets contributes to its potential for deployment in clinical settings, providing clinicians with a valuable decision support system.