中文題目：用結合人工智慧心電圖偵測左心室功能失調及預測心血管疾病

英文題目：Artificial intelligence-enabled electrocardiography enhances the detection of left ventricular dysfunction and independently predicts future cardiovascular outcomes

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BACKGROUND

Ejection fraction (EF) provides critical information about heart failure (HF) and management. Electrocardiography (ECG) is a noninvasive screening tool for cardiac electrophysiological activities that has been used to detect patients with low EF. However, no studies have widely investigated its clinical impacts.

OBJECTIVE

This study developed a deep learning model (DLM) to estimate EF via ECG (ECG-EF). We further investigated the relationship between ECG-EF and echo-based EF (ECHO-EF) and explored their contributions to future cardiovascular adverse events.

METHODS

There were 57,206 ECGs with corresponding echocardiograms used to train our DLM. We compared a series of training strategies and selected the best DLM. Next, 10,762 ECGs were used for validation, and another 20,629 ECGs were employed to conduct the accuracy test. We compared the change between ECG-EF and ECHO-EF. The primary follow-up adverse events included future ECHO-EF changes and major adverse cardiovascular events (MACEs), including cardiovascular-related death, non—cardiovascular death, acute myocardial infarction, and stroke. The risks of all-cause mortality, new-onset diabetes mellitus, hypertension, and chronic kidney disease were also analyzed.

RESULTS

The sex-/age-matching strategy-trained DLM achieved the best areas under the curve (AUCs) of 0.9472 with sensitivity of 86.9% and specificity of 89.6% in the follow-up cohort with a correlation of 0.603 and a mean absolute error of 7.436. In the accurate cases (difference <10% at initial), the change traces of ECG-EF and ECHO-EF were consistent (R-square = 0.351). Patients with lower ECG-EF exhibited greater risk of cardiovascular (CV) complications, slower ECHO-EF recovery, and faster ECHO-EF deterioration in patients with normal ECHO-EF. Importantly, ECG-EF demonstrated an independent impact on MACEs and all CV adverse outcomes, with better prediction of CV outcomes than ECHO-EF.

CONCLUSIONS

The ECG-EF could not only be used to initially screen asymptomatic LV dysfunction but also independently contribute to the predictions of future CV adverse events. Although further large-scale studies are warranted, ECG-EF could serve as a promising diagnostic support and management guided tool for CV diseases in future clinical cardiac studies.