Artificial intelligence-based identification of left ventricular systolic dysfunction from 12-lead electrocardiograms: External validation and advanced application of an existing model

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Background: The diagnostic application of artificial intelligence (AI)-based models to detect cardiovascular diseases from electrocardiograms (ECG) evolves and some promising results were reported. However, most published algorithms lack external validation.

Purpose: Aim of this study was to validate an existing, open-source algorithm for the detection of left ventricular systolic dysfunction (LVSD) from 12-lead ECGs.

Methods: Patients with digitalized data pairs of 12-lead ECGs and echocardiography (at intervals of ≤7 days) were retrospectively selected from the Heart Center Leipzig ECG and electronic medical records databases. A previously developed AI-based model was applied to ECGs and calculated probabilities for LVSD. Area under the receiver operating characteristic curve (AUROC) was computed overall and in cohorts stratified for baseline and ECG characteristics. Repeated echocardiography studies recorded ≥3 months after index diagnostics were used for follow-up (FU) analysis.

Results: At baseline, 42,291 ECG-echocardiography pairs were analyzed and AUROC for LVSD detection was 0.88. Corresponding sensitivity and specificity were 82% and 77% for the optimal LVSD-probability cutoff based on Youden’s J. AUROCs were lower in ECG-subgroups with tachycardia, atrial fibrillation and wide QRS complex. In patients without LVSD at baseline and available FU, model-generated high probability for LVSD was associated with a 4-fold increased risk of developing LVSD during FU.

Conclusion: We provide the external validation of an existing AI-based ECG-analyzing model for the detection of LVSD with excellent and robust performance metrics. The association of false positive LVSD screenings at baseline with a deterioration of ventricular function during FU is hypothesis-generating and deserves further research.