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Pediatric and Congenital Heart Disease

DEEP LEARNING-BASED ELECTROCARDIOGRAM ANALYSIS TO PREDICT BIVENTRICULAR DYSFUNCTION AND DILATION IN CONGENITAL HEART DISEASE

Moderated Poster Contributions
Moderated Poster Theater 06
Sunday, April 7, 2024, 11:30 a.m.-11:40 a.m.

Session Title: Congenital Heart Disease Population Health
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Background: Artificial intelligence-enhanced ECG (AI-ECG) analysis can detect LV dysfunction in structurally normal hearts. This study explores AI-ECG analysis in patients with congenital heart disease (CHD) to detect biventricular dysfunction and dilation.

Methods: A convolutional neural network was trained (80%) and tested (20%) on ECG-cardiac magnetic resonance (CMR) pairs (≤ 30 days apart) to detect the primary outcomes: LV dysfunction (EF ≤ 40%), RV dysfunction (EF ≤ 35%), LV dilation, and RV dilation (end-diastolic volume z-scores > 4). Model performance was evaluated on the test set. Saliency mapping was used to identify ECG features influencing predictions.

Results: The main cohort comprised of 8,584 ECG-CMR pairs (4,941 patients; median age 20.7 years; 4.4% deaths). Outcome prevalence was LV dysfunction 3.3%, LV dilation 7.9%, RV dysfunction 4.5%, and RV dilation 18.6%. Model performance was robust across all primary outcomes (Figure). In a subgroup analysis, dysfunction performance was similar in tetralogy of Fallot and lower in single ventricles. Patients with AI-ECG predicted high-risk of dysfunction had decreased survival (Figure; both p<0.001). Saliency mapping revealed precordial leads V4 and V6 are most influential in predicting all outcomes, with emphasis on QRS widening and T wave inversion.

Conclusion: AI-ECG shows promise to detect ventricular dilation and dysfunction in CHD patients, which may improve resource utilization and inform timing of surveillance imaging.

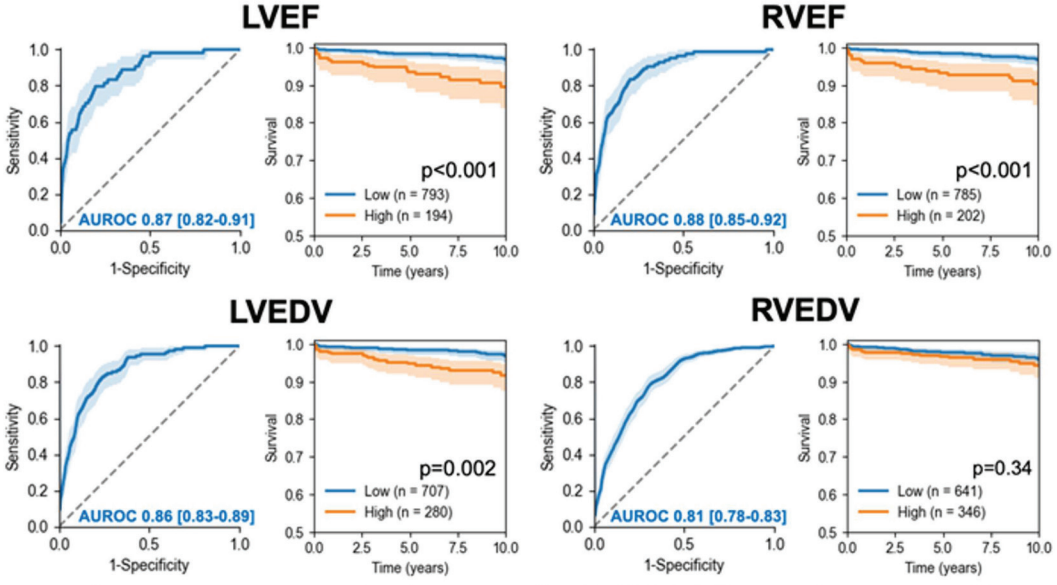

Figure: Area under the receiver operating characteristic (AUROC [95% CI]) for each primary outcome of interest (left), with patient survival after CMR (right) when stratifying by high (orange) or low (blue) risk AI-ECG predictions.