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Unmasking HFpEF With Artificial Intelligence: A Disruptive Opportunity for Disease Detection

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Heart failure with preserved ejection fraction (HFpEF) is a highly prevalent clinical syndrome that accounts for the majority of cases of HF around the world. The prevalence of HFpEF has previously been reported to be between 1% and 5.5% of the general population.[1] However, this rate may be underestimated, given that diagnosis remains challenging, owing to the multitude of various etiologies and presentations that can be attributed to HFpEF.[2] With newly available therapies, making earlier diagnoses of HFpEF has the potential to change significantly the trajectory of a patient's disease course.[3]

Clinical scoring systems such as H2FPEF have been validated as important diagnostic methods for HFpEF diagnosis, but advances in artificial intelligence (AI) technologies have allowed for novel approaches to HFpEF diagnosis by way of automated analysis of echocardiograms. A novel AI-based analysis tool that uses a single, 4-chamber apical view from a transthoracic echocardiogram to screen for HFpEF has been developed and cleared by the Federal Drug Administration (EchoGo Heart Failure, Ultromics, Oxford, UK). However, real-world evaluation at scale has been limited. The purpose of this study was to evaluate whether an AI system can detect HFpEF reliably, compared to routine echocardiographic analysis.

Methods

We aimed to assess the performance of this software in a real-world setting, so as to better estimate the prevalence of HFpEF in our population of patients. We retrospectively evaluated clinical echocardiograms performed, and we compared the AI analylsis with clinical interpretations of echocardiograms. For all patients screened as being positive for HFpEF, we performed a manual chart review, including calculating an HF2PEF score to ascertain clinical risk factors that corroborated the diagnosis.

Results

We performed a comprehensive analysis using the AI HFpEF algorithm of 692 consecutive clinical echocardiograms from unique patients. We excluded 71 studies because of suboptimal transthoracic echocardiogram image quality, whereas 89 were noted to have LVEF $<$ 50%. Of the remaining 532 studies with LVEF $>$ 50%, 117 (16.9% of 692) screened as being positive for HFpEF.

Of these 117 patients, 56 (47.9% of 117) had documented HFpEF or HF with improved EF. Of the remaining patients, 33 (28.2% of 117) had documented structural heart diseases (moderate or greater valve stenosis or regurgitation, valve repair/replacement, heart transplant), which are associated with HFpEF. Of the remaining 28 patients, 17 had HF2PEF scores of at least 50% (moderate or higher probability of HFpEF),[4] and 11 had incomplete HF2PEF scores (due to lack of interpretable tricuspid regurgitation continuous-wave Doppler signal, precluding estimate of pulmonary artery systolic pressure).

Discussion

The diagnosis of HFpEF is made clinically by using supportive tools such as the HF2PEF score. This score

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requires knowledge of clinical and echocardiographic information and is not conventionally documented in an echocardiographic report. Similarly, the presence of diastolic dysfunction reported on an echocardiogram is not synonymous with HFpEF. Efforts to improve and simplify the recognition of HFpEF by using echocardiography alone would likely lead to earlier intervention.

Our study demonstrates that the real-world use of AI echocardiography analysis is able to detect HFpEF from the echocardiogram alone, without additional clinical information. Fewer than half the patients in our cohort who screened positive for HFpEF had chart-documented histories of HFpEF. Furthermore, for the 28 patients in whom an HFpEF score may have been calculated, 11 of them (39.3%) had no measurable tricuspid regurgitation Doppler, rendering the HF2PEF score incomplete. These 28 patients represent 23.9% of the overall 117 patients who would otherwise have required either an HF2PEF score or integration of clinical information to diagnose HFpEF.

This AI HFpEF detection algorithm represents a step forward in being able to identify correctly patients at risk for adverse events. It can be readily integrated in existing echocardiography reporting systems and, if used at scale, it would mark a paradigm shift in the way imaging is used to raise the suspicion or, perhaps, to diagnose HFpEF. Further outcomes data are needed to discern the ways in which this could change downstream testing and the disease management of patients with HFpEF.

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CRediT authorship contribution statement

AMOGH KARNIK: Writing – review & editing, Writing – original draft, Visualization, Software, Formal analysis, Data curation. **MADELINE JANKOWSKI:** Resources, Data curation. **AKHIL NARANG:** Writing – review & editing, Supervision, Conceptualization.

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