Performance of an Automated Echocardiographic Artificial Intelligence Model. To detect subclinical Heart Failure with preserved Ejection Fraction (HFpEF) in Community-dwelling older adults

Vinayak Subramanian [1], Alvin Chandra [1], Matthew Segar [2], Katarina Yaros [1], Ross Upton [3], Ashley Akerman [3], Amil Shah [1], Ambarish Pandey [1]

[1] UT Southwestern Medical Center, [2] Texas Heart Institute, [3] Ultromics

UT Southwestern Medical Center

Background

- Heart failure with preserved ejection fraction (HFpEF) is common among older adults
- Progression of HF involves subclinical changes in cardiac structure and function (Stage B) which precede development of clinical symptoms (Stage C)
- Early identification of subclinical HFpEF can prompt initiation of therapies to prevent clinical HF
- Scalable strategies for identification of subclinical HFpEF are lacking
- The purpose of this study was to evaluate the performance of a validated, automated echocardiographic artificial Intelligence algorithm (Ultromics, UK) to identify subclinical HFpEF among community-dwelling individuals without HF

Methods

- Participants of the Dallas Hearts and Mind Study without history of HF were included.
- Participants underwent cardiovascular phenotyping with:
  - Echocardiography at rest and during submaximal exercise
  - Peak exercise oxygen uptake (VO_{2peak}) measurement using cardiopulmonary exercise testing
- Subclinical HFpEF was defined as the presence of resting or exercise E/e >14, and Peak Exercise capacity <25th percentile for age and sex
- Resting Echocardiograms were analyzed using the Ultromics EchoGo Algorithm to detect subclinical HFpEF
- Association between the AI-HFpEF phenotype and measures of cardiac structure and function were assessed using linear and logistic regression models
- Performance of the EchoGo AI algorithm was determined by the Area under the receiver operator curve
- Performance of EchoGo AI algorithm was compared with the previously validated H2FpEF score

Table 1: Baseline Characteristics

Characteristic	Overall DHMS (n = 460)	AI-HFpEF (n =76)	P-value
Age	61	67	<0.001
Female Sex (%)	57	57	1.0
Black Race (%)	49	57	0.4
Diabetes (%)	20	32	0.007
Hypertension	55	83	<0.001
Hyperlipidemia (%)	49	64	0.007
Coronary Artery Disease (%)	6.2	20	<0.001
Smoking (%)	10	19	0.02
BMI, kg/m^2	31.1	33.5	<0.001
Systolic Blood Pressure	131	143	<0.001
LV Ejection Fraction, %	60	58	0.01
LV Mass, g	157	195	<0.001
Resting Avg E/e'	9	13	<0.001
VO_{2peak}, mL/kg/min	16.9	11.1	<0.001

Figure 1: Receiver Operator Characteristic Curves for Diagnosis of Subclinical HFpEF

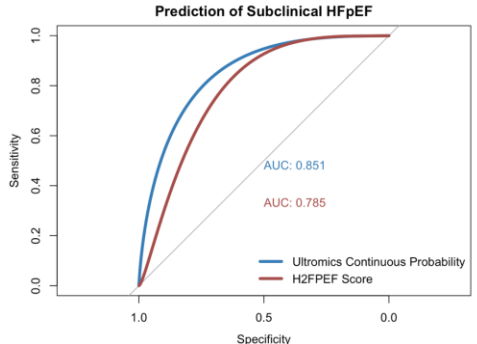

Table 2: Association of AI-HFpEF phenotype with Measures of Cardiac Structure and Function

Outcomes	Adjusted Estimate (95% CI)	P-Value
Subclinical HFpEF (yes vs. no)	9.67 (2.16 – 43.2) *	0.003
Stress E/e'	3.83 (2.25 – 5.42) #	<0.001
Peak Exercise Oxygen Uptake (VO_{2peak})	-4.83 (-9.37 – 0.3) #	0.04
Resting LA Reservoir Strain	-7.32 (-11.56 – -3.08) #	0.001
Resting LV Global Longitudinal Strain	3.94 (1.04, 6.83) #	0.008

Logistic regression model used for dichotomous outcomes of subclinical HFpEF (yes vs. no). Linear regression models were used for continuous outcomes. Separate models were constructed for each outcome with adjustments for: Age, Sex, Race, history of smoking, diabetes, hypertension, coronary artery disease, hyperlipidemia, systolic blood pressure, heart rate, Body Mass Index, Left ventricular mass. HFpEF: Heart failure with preserved ejection fraction; LA: Left Atrial; LV: Left ventricular; CI: Confidence interval;
*odds ratio for dichotomous outcome as determined by the logistic regression model
#Parameter estimates for continuous outcomes as determined by linear regression models

Conclusions

- Subclinical HFpEF phenotype identified by an AI-HFpEF algorithm is characterized by a higher burden of traditional cardiovascular risk factors and comorbidities
- HFpEF probability by the EchoGo algorithm is strongly associated with echocardiographic measures of cardiac structure and function, and exercise capacity
- Automated Echocardiographic Analysis by the EchoGo AI algorithm can identify subclinical HFpEF in a cohort of community dwelling individual without symptoms of HF
- The EchoGo AI algorithm has higher Area under the Receiver Operator Curve compared to the previously validated H2FpEF score