

# Association of a Novel, Non-invasive AI Model to Automate Echocardiographic Detection of Heart Failure with Preserved Ejection Fraction (HFpEF) with Invasive Hemodynamics

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## INTRODUCTION

Current gold standard for diagnosing heart failure with preserved ejection fraction (HFpEF) is invasive exercise hemodynamics. Emerging technologies, including AI-based software platforms have demonstrated utility for identifying HFpEF, but lack comparative validation to invasive hemodynamics at rest or during exercise. The objective of the study was to assess the accuracy of EchoGo Heart Failure in patients with hemodynamic presentation of HFpEF.

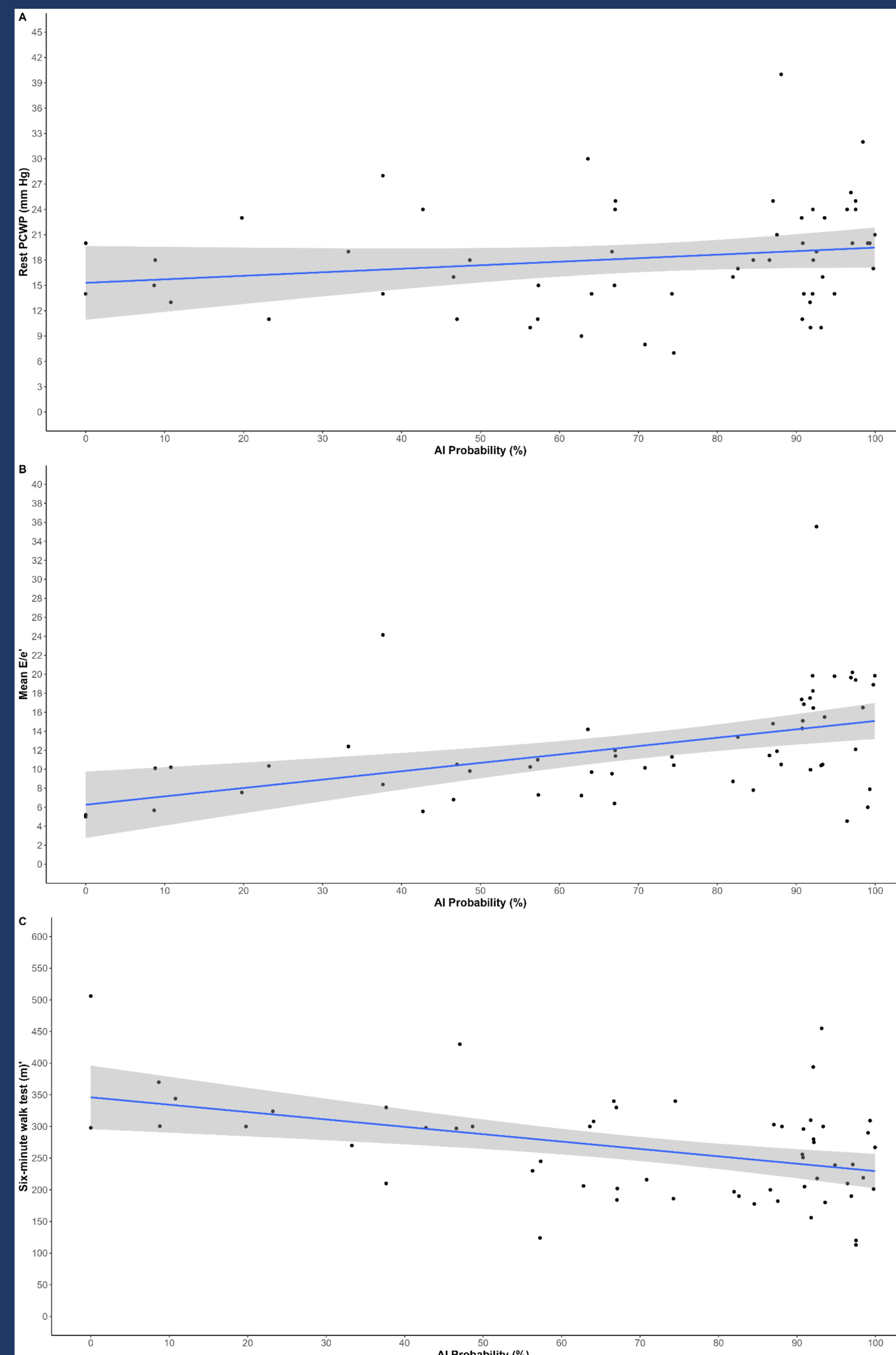
## METHODS

Patients with New York Heart Association Class II, III or ambulatory IV heart failure with LVEF  $\geq 40\%$  and elevated PCWP during supine ergometry ( $\geq 25$  mmHg) were included in the evaluation. These patients represent a subset of a previously published cohort (Udelson et al., 2023, JACC Heart Failure). Exercise hemodynamics and echocardiography were performed at baseline and 1 month following creation of a no-implant interatrial shunt (Alleivant Medical). AI-based assessment of echocardiograms was performed using previously published algorithm (Akerman et al., 2023, JACC Advances) EchoGo Heart Failure (v2.0, Ultromics Ltd, Oxford, UK). AI-derived classification (HFpEF vs. non-HFpEF) and continuous probability of HFpEF were compared to PCWP at rest and exercise, mean E/e', 6-minute walk test, and Kansas City Cardiomyopathy Questionnaire (KCCQ) to evaluate the association with hemodynamic, functional, and patient-reported outcomes.

## RESULTS

Prior to shunt creation, AI accuracy was 86% (95% CI: 68, 100) in 29 hemodynamically-diagnosed patients (**Table 1**). Accuracy was 82% (95% CI: 58, 100) in 20 of these patients who had "manifest" HFpEF (rest PCWP  $\geq 15$  mmHg) and was 100% accurate in 9 patients with "occult" HFpEF (rest PCWP  $< 15$  mmHg, exercise PCWP  $\geq 25$  mmHg). One month following shunt creation, PCWP decreased by -2.4 mmHg at rest ( $p=0.065$ ,  $n=29$ ), and -7.4 mmHg during exercise ( $p<0.001$ ,  $n=29$ ), and was associated with a modest decrease in AI prediction probability (-7%;  $p=0.256$ ). Overall, EchoGo Heart Failure was moderately associated with invasive hemodynamics (**Table 2**), and moderate to strong associations with echocardiographic (E/e'), functional (6MWT) and patient-reported outcomes (KCCQ).

A novel non-invasive echocardiographic AI model was able to accurately detect HFpEF in interatrial shunt patients, even when hemodynamics were not elevated at rest ("occult" HFpEF). The AI predictions were associated with hemodynamic, echocardiographic, functional, and patient-reported outcomes.



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## CONCLUSION AND DISCUSSION

This initial data indicates that EchoGo Heart Failure is potentially a valuable tool for diagnosing HFpEF without the need for invasive exercise hemodynamics. Future studies are required to determine the clinical utility of such tools in the screening and medical management of HFpEF.

## TABLES

**Table 1.** Baseline Characteristics (n=29)

Age, y	68.7 $\pm$ 7.8
Sex, % female	65.5
LVEF, %	59.6 $\pm$ 10.0
BMI, kg/m <sup>2</sup>	35.5 $\pm$ 7.3
NYHA Functional Class I-IV, n (%)	
Class II	7 (24.1)
Class III	22 (75.9)
Prior HF Hospitalization	26 (89.7)
Hypertension	26 (89.7)
Diabetes	10 (34.5)
Atrial Fibrillation/Flutter	8 (27.6)
KCCQ Overall Summary Score	27.7 $\pm$ 10.7
6MWT, meters	238.6 $\pm$ 63.9
NT-proBNP, pg/mL	1128.6 $\pm$ 867.6
RAP Rest, mmHg	10.1 $\pm$ 3.8
Mean PAP Rest, mmHg	27.1 $\pm$ 7.7
PCWP Rest, mmHg	19.4 $\pm$ 7.4
PCWP Peak Exercise, mmHg	40.0 $\pm$ 10.9
PVR Rest, WU	1.3 $\pm$ 1.1
Mean E/e'	12.5 $\pm$ 5.1

**Table 2.** AI Prediction Correlation Statistics

PCWP Rest	All HFpEF	Manifest HFpEF	Occult HFpEF
Baseline	0.144	0.178	0.153
1 month	0.223	0.246	0.004
1 month - Baseline	0.147	0.405	-0.261
<b>E/e'</b>			
Baseline	0.309	0.207	0.734
1 month	0.556	0.594	0.648
1 month - Baseline	0.497	0.618	-,0.162
<b>Six-minute Walk Test Distance</b>			
Baseline	-0.432	-0.388	-0.600
1 month	-0.404	-0.677	-0.168
1 month - Baseline	-0.307	-0.340	-0.186
<b>KCCQ Overall Summary Score</b>			
Baseline	-0.444	-0.378	-0.712
1 month	-0.053	-0.111	-0.128
1 month - Baseline	-0.006	-0.053	-0.042

## DISCLOSURE INFORMATION

AA and RU are affiliated with Ultromics Ltd.

## REFERENCES

Udelson et al., 2023, JACC Heart Failure, <https://doi.org/10.1016/j.jchf.2023.01.024>  
Akerman et al., 2023, JACC Advances <https://doi.org/10.1016/j.jacadv.2023.100452>