

Handheld Echocardiography with Artificial Intelligence for Comprehensive Left Ventricular Diastolic Dysfunction Evaluation in Preoperative Patients

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PURPOSE / OBJECTIVES

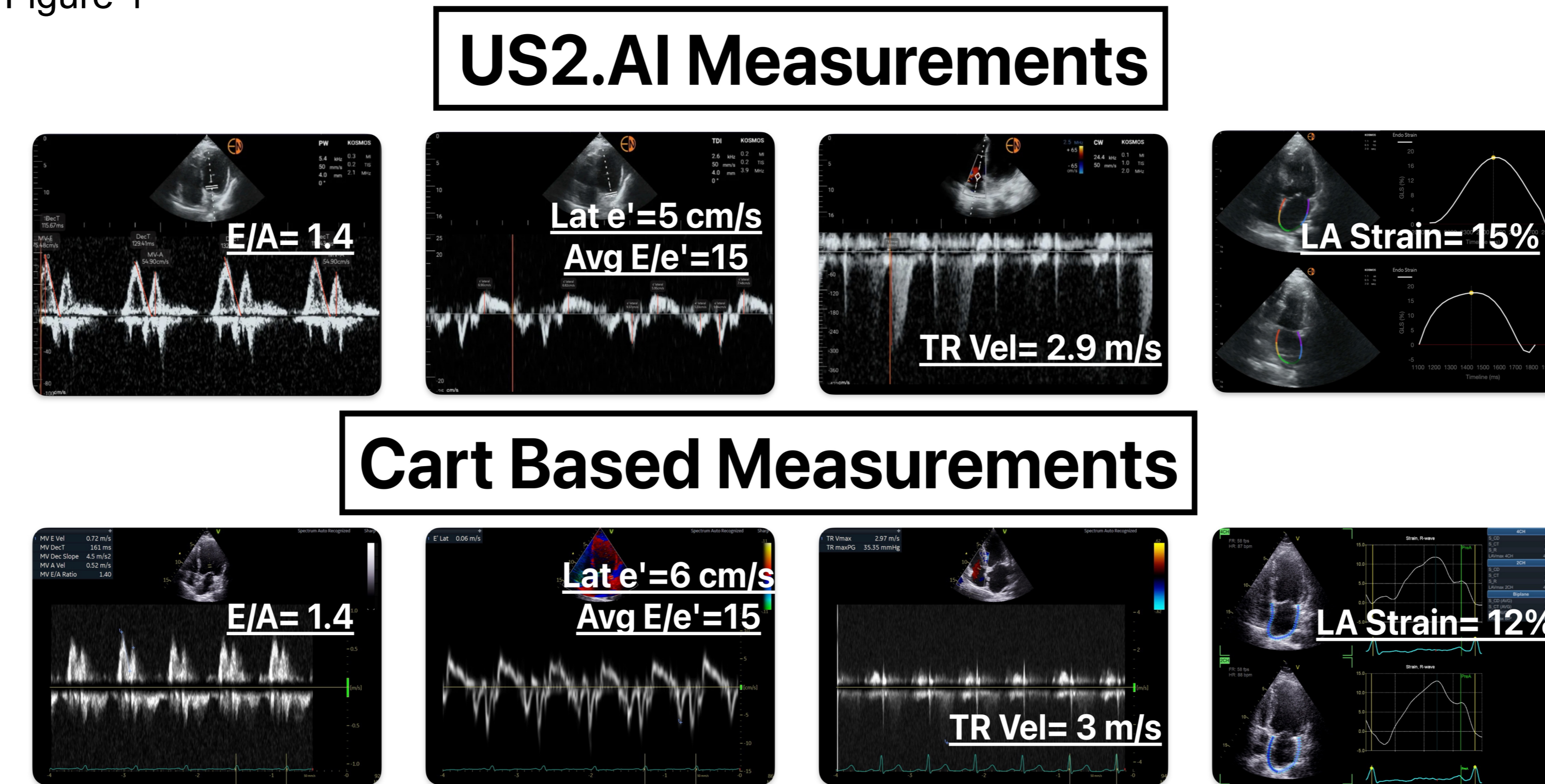
Previous studies using handheld echocardiography devices mainly focused on ejection fraction (EF) calculations or individual parameters of left ventricular diastolic function (LVDD) like E/e'. With evolution of handheld devices equipped with CWD and artificial intelligence (AI) it is possible to comprehensively assess LVDD.

The aim of this study was to evaluate the feasibility of a handheld echocardiography device (Echonus Inc with Kosmos tablet) with an AI software (US2.AI) to comprehensively assess LVDD and compare results from the handheld echocardiography with the cart-based echocardiography in preoperative patients.

MATERIAL & METHODS

- Prospective observational study, after IRB approval study was registered with CTRI no. CTRI/2024/10/075737.
- Sample size = Sixty-five patients undergoing various cardiac and non-cardiac surgeries
- Patients had an echo exam done by both cart-based and handheld echo devices in a random order.
- After handheld exam was over the study was uploaded on US2.AI platform and results were automatically generated. The cart-based measurements were done by clinician.
- All the parameters necessary to classify LVDD by American and British Society of Echocardiography guidelines (ASE and BSE) were obtained (Sample Patient in Figure 1). This included EF, Tissue Doppler Velocities at septal and lateral mitral annulus (e'), Mitral inflow velocity (E & A), ratio of E/e', Tricuspid regurgitation velocity, left atrial volumes indexed (LAVi) and left atrial strain (LAS) parameters.
- Various parameters were compared to assess method agreement using the intraclass correlation coefficient (ICC), linear regression analysis (Pearson's coefficient r), and Bland-Altman analysis.
- Diagnostic accuracy for the LVDD grades was calculated.

Figure 1



The Handheld Echo device Echonus equipped with AI software US2.AI can comprehensively measure all the parameters and categorise LVDD as compared to standard cart-based Echo machine.

CONCLUSION

The handheld device equipped with AI can comprehensively detect LVDD in preoperative patients as compared to standard cart based echo exam and it's use can be recommended.

RESULTS

- The handheld and cart-based measurements showed good to excellent agreement (ICC 0.72 to 0.98; P < 0.001 for all). Excellent correlations were found between the different parameters (Figure 2).
- Several metrics showed a slight variation with acceptable ranges of agreement (Figure 3/Table 1).
- For both ASE and BSE grades of LVDD, there was a statistically significant agreement between US2.AI and Cart (Kohen's Kappa 0.98 and 0.93 respectively; p<0.001).

Figure 2

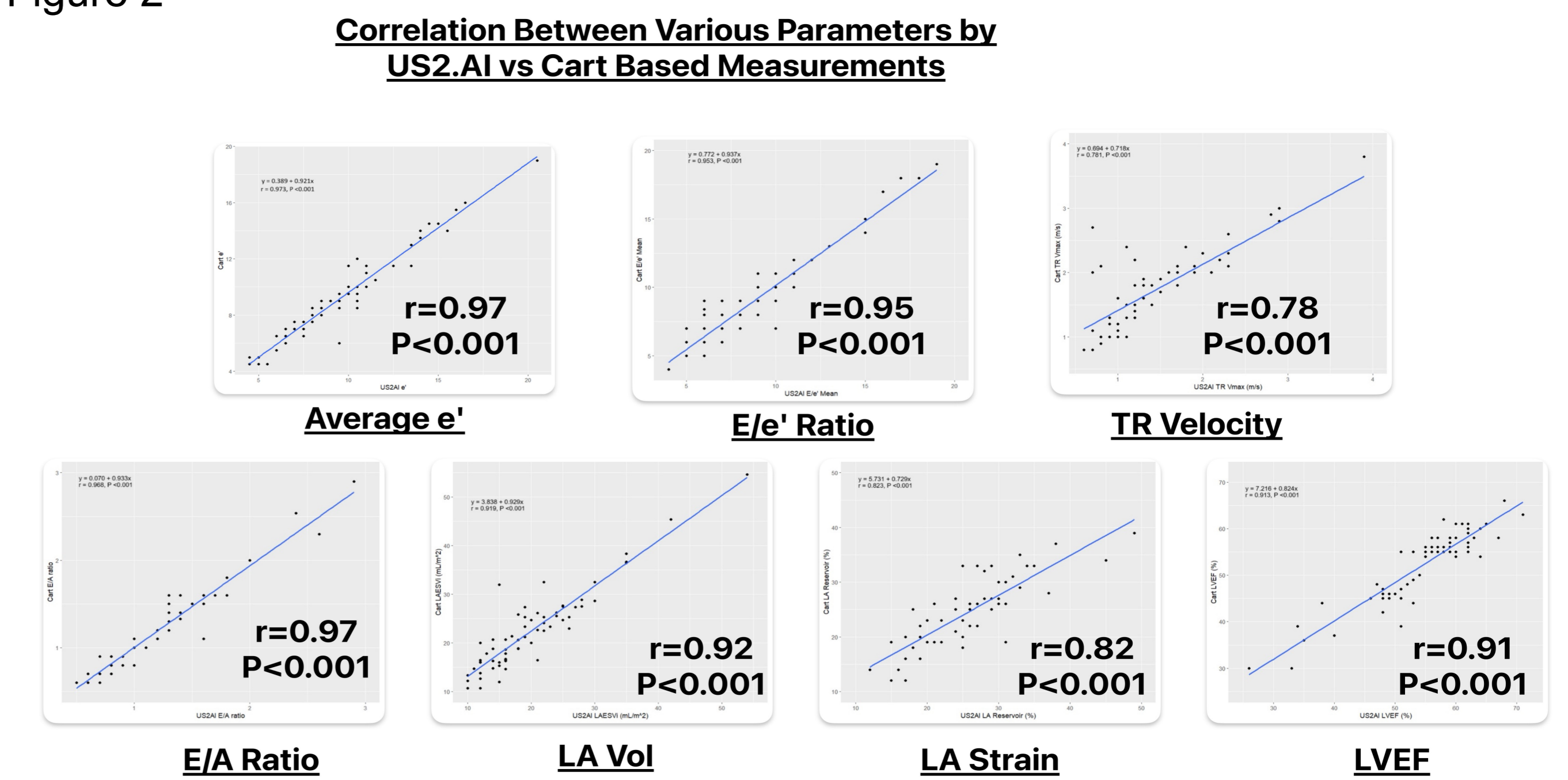


Figure 3/ Table 1

Difference and agreement between US2AI and Cart for different measurements

Variables	Mean difference ± SD	LoA	Range
e'	-0.346 ± 0.785	-1.885; 1.193	3.078
E/e' Mean	0.206 ± 1.031	-1.814; 2.226	4.040
TR Vmax	0.275 ± 0.44	-0.587; 1.137	1.724
LAESVi	2.421 ± 3.291	-4.03; 8.872	12.902
E/A ratio	-0.005 ± 0.123	-0.245; 0.235	0.480
LA Reservoir	-1.25 ± 4.024	-9.137; 6.637	15.774
LVEF	-2.446 ± 3.527	-9.359; 4.466	13.825