Feasibility and accuracy of assessing left ventricular systolic function by measuring left ventricular ejection fraction using a hand-held echocardiography device with an automated algorithm

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BACKGROUND

Heart failure (HF) prevalence continues to rise as management is still applied late in the disease trajectory. Risk of death and HF hospitalization in patients with asymptomatic left ventricular systolic dysfunction (LVSD) can be reduced with existing treatments, however identifying these high-risk individuals is still required. Hand-carried ultrasound (HCU) is a potential solution, however experienced operators and high-end ultrasound devices preclude its potential for screening or monitoring. With recent technologies permitting automation in left ventricular ejection fraction (LVEF) assessment, (the preferred method in identifying LVSD), integration of automated algorithms into HCU devices could permit focussed, point-of-care LVEF assessments by non-specialised staff for screening and monitoring for LVSD, reducing global HF burden. In collaboration with General Electric (GE) Precision Healthcare, Royal Brisbane and Women's Hospital Cardiology assessed a HCU prototype integrated with novel automated software to measure LVEF.

OBJECTIVES

We aimed to determine the accuracy and feasibility of automated LVEF assessment using HCU integrated with a novel, AI assisted automatic single-plane LVEF algorithm (AutoEF).

METHODS

Thirty patients in sinus rhythm undergoing clinically indicated cardiac ultrasound examination (including standard LVEF assessments; GE Vivid E9) all with optimal image quality, also had AutoEF assessments performed within 24hrs (LVivo EF App on GE Vscan Extend™), using an apical four chamber view acquisition (see Figure 1). AutoEF measures (end-diastolic volume 'EDV', end-systolic volume 'ESV', LVEF) were all respectively compared to standard cardiac ultrasound (echocardiography) single-plane LVEF (SPEF) using Bland-Altman (mean bias with limits of agreement 'LOA', absolute (#) mean difference and relative (%) mean difference. Diagnostic accuracy of AutoEF was assessed using receiver operating characteristic (ROC) with standard 3D-echocardiographic LVEF as the reference standard (cut-off <50%; See Figure 2). AutoEF intra-observer reproducibility was also assessed.

METHODS cont'd

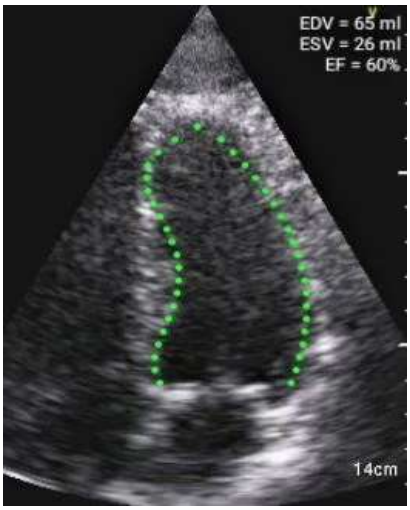

Figure 1: AutoEF assessment via GE Vscan Extend™ (apical four chamber view) using the LVivo EF App.

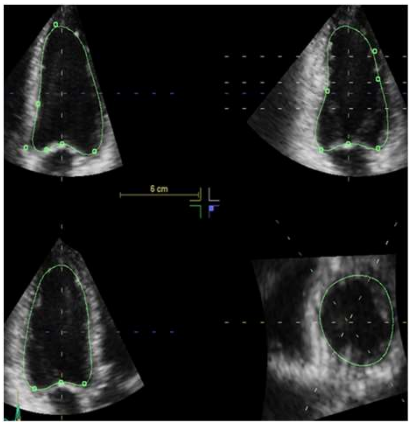

Figure 2: LVEF assessment via standard 3D-echocardiography (GE Vivid E9).

RESULTS

In the 30 patients (59% male), the mean age was 54 years (±18), and had a 3D-echocardiographic LVEF of 58% (±11; range 26%-68%). AutoEF was feasible in 29 of these patients (97%).

RESULTS cont'd

Intra-observer variability in AutoEF assessment (n=19; separate image acquisitions) demonstrated absolute mean differences of 7±8ml for EDV; 4±5ml for ESV, and 1.7±1.2% for LVEF. AutoEF was comparable to SPEF, see Table 1.

Measurement:	EDV (ml)	ESV (ml)	LVEF (%)
Bland-Altman (bias with LOA)	-4.7 (-41,+31)	-0.6 (-21,+20)	-1.7 (-15,+11)
Absolute mean diff (#)	14.3±12	7.3±7	5.1±4.6
Relative mean diff (%)	14±10	17±17	10±9

Table 1: AutoEF measures compared to SPEF measures.

When assessed for diagnostic utility using <50% 3D-echocardiography LVEF as a binary cut-off for abnormal left ventricular systolic function, AutoEF ROC demonstrated an AUC of 0.96 at ≤49% with a sensitivity of 100% and a specificity of 88% (see Figure 3).

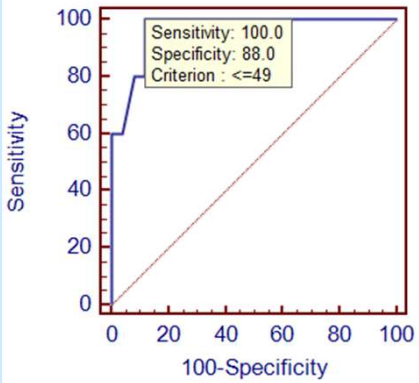

Figure 3: ROC curve of AutoEF with 3D-echocardiography LVEF as reference (<50% cut-off).

CONCLUSION

AutoEF measurement via HCU is highly feasible and reproducible. SPEF and AutoEF were comparable, and ROC analysis suggests HCU AutoEF may allow reliable detection of reduced LVEF in patients with optimal image quality using single plane acquisition. Further investigations should evaluate accuracy when used by non-specialised staff.