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Comparison of real time 3-dimensional echocardiography with cardiovascular magnetic resonance for left ventricular volumetric assessment - a real world study

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Study objective

To assess the accuracy and reproducibility of real time 3-dimensional echocardiography (RT3DE) for left ventricular (LV) volumetric assessment in consecutive, unselected patients.

Introduction

The accuracy and reproducibility of RT3DE for LV volumetric assessment has been demonstrated in a number of clinical trials. We aimed to assess the 'real-world' accuracy and reproducibility of RT3DE in consecutive, unselected patients.

Methods

Sixty patients undergoing clinically indicated cardiac magnetic resonance imaging (CMR) also underwent RT3DE. CMR images were obtained using a 1.5 T scanner (Siemens Avanto, Germany) equipped with a 32-channel surface coil. RT3DE images were obtained using an IE33 scanner (Philips, USA). LV volumes and ejection fraction (EF) were measured by 2 independent observers for both modalities. RT3DE measurements were compared to those obtained by CMR. Inter-observer reproducibility was assessed, and 25% of scans were re-analysed to assess intra-observer reproducibility. RT3DE image quality was independently graded as good, adequate and non-analysable.

Results

Only 13 patients (22%) were deemed to have good RT3DE image quality by both observers. In these patients, RT3DE measurement of EF correlated highly with CMR (mean+standard deviation -2.0 + 4%, r = 0.97, Bland-Altman 95% levels of agreement (BA) -9 to 5%). LV volumes were underestimated by RT3DE (end diastolic volume (EDV) -26 + 23 mls, end systolic volume (ESV) -10 + 19 mls) in keeping with findings from other studies. Inter-observer reproducibility for measurement of EF was high (1.2+ 3%, r = 0.98, BA -5 to 7%); as was intra-observer reproducibility (0.1 + 2%, r = 0.99, BA -4 to 4%) (Table 1). 29 patients had adequate RT3DE image quality. In these patients, correlation of RT3DE and CMR measurement of EF was significantly lower (-0.5 + 9, r = 0.82, BA -19 to 18%). LV volumes were underestimated to a greater degree (EDV -39 + 31 mls, ESV -11 + 31 mls) and inter-observer (-1.2 + 6%, r = 0.84, BA -13 to 10%) and intra-observer reproducibility (0.5 + 4, r = 0.97, -7 to 8%) were also considerably lower (Table). RT3DE image quality was deemed non-analysable in 18 patients (30%), with inadequate visualisation of the anterior wall alone being responsible in 10 (56%).

Conclusion

In this real-world study, RT3DE LV volumetric assessment was comparable to CMR when RT3DE image quality was good. However, image quality was good in only 22% of patients. In the remaining 78%, image quality was such

Table 1:

	Mean difference +/- SD (%)	*p*-value	Correlation coefficient (r)	Bland-Altman 95% limits of agreement (%)	Range of Bland-Altman Limits of agreement (%)
RT3DE versus CMR					
Good images	-2.0 +/- 4	0.87	0.97	-9 to 5	14
Adequate images	-0.5 +/- 9	0.78	0.82	-19 to 18	37
RT3DE Inter-observer reproducibility					
Good images	1.2 +/- 3	0.23	0.98	-5 to 7	12
Adequate images	-1.2 +/- 6	0.25	0.84	-13 to 10	23
RT3DE Intra-observer reproducibility					
Good images	0.1 +/- 2	0.87	0.99	-4 to 4	8
Adequate images	0.5 +/- 4	0.61	0.97	-7 to 8	15

that RT3DE assessment was either not possible or accuracy and reproducibility were significantly lower. Because CMR can obtain good image quality in a greater proportion of patients, it remains the gold standard for LV volumetric assessment.