Feasibility and accuracy of the automated software for dynamic quantification of left ventricular and atrial volumes and function in a large unselected population

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Objective. Preliminary studies showed the accuracy of machine learning based automated dynamic quantification of left ventricular (LV) and left atrial (LA) volumes. We aimed to evaluate the feasibility and accuracy of machine learning based automated dynamic quantification of LV and LA volumes in an unselected population.

Methods. We enrolled 600 unselected patients (12% in atrial fibrillation) clinically referred for transthoracic echocardiography (2DTTE), who also underwent 3D echocardiography (3DE) imaging. LV ejection fraction (EF), LV and LA volumes were obtained from 2D images; 3D images were analysed using Dynamic Heart Model (DHM) software (Philips) resulting in LV and LA volume-time curves. A subgroup of 140 patients underwent also cardiac magnetic resonance (CMR) imaging. Average time of analysis, feasibility, and image quality were recorded and results were compared between 2DTTE, DHM and CMR.

Results. The use of DHM was feasible in 522/600 cases (87%). When feasible, the boundary position was considered accurate in 335/522 patients (64%), while major (n = 38) or minor (n = 149) borders corrections were needed. The overall time required for DHM datasets was approximately 40 seconds, resulting in physiologically appearing LV and LA volume–time curves in all cases. As expected, DHM LV volumes were larger than 2D ones (end-diastolic volume: 173 ± 64 vs 142 ± 58 mL, respectively), while no differences were found for LV EF and LA volumes (EF: 55%±12 vs 56%±14; LA volume 89 ± 36 vs 89 ± 38 mL, respectively). The comparison between DHM and CMR values showed a high correlation for LV volumes ($r = 0.70$ and $r = 0.82$, $p < 0.001$ for end-diastolic and end-systolic volume, respectively) and an excellent correlation for EF ($r = 0.82$, $p < 0.001$) and LA volumes.

Conclusions. The DHM software is feasible, accurate and quick in a large series of unselected patients, including those with suboptimal 2D images or in atrial fibrillation.

Table 1

		DHM quality		Adjustment	
	Feasibility	Good	Suboptimal	Minor	Major
Total of patients (n, %)	522/600 (87%)	327/522 (62%)	195/522 (28%)	149/522 (29%)	38/522 (6%)
Normal subjects (n, %)	39/40 (97%)	23/39 (57%)	16/39 (40%)	9/39 (21%)	1/39 (3%)
Atrial Fibrillation (n, %)	59/73 (81%)*	28/59 (47%)	31/59 (53%)	15/59 (25%)	6/59 (10%)
Valvular disease (n, %)	271/312 (87%)	120/271 (%)	151/271 (%)	65/271 (24%)	16/271 (6%)
Coronary artery disease (n, %)	47/58 (81%)*	26/47 (46%)	21/47 (37%)	16/47 (34%)	5/47 (11%)
Miscellaneous (n, %)	24/25 (96%)	18/24 (75%)	6/24 (25%)	5/24 (21%)	3/24 (12%)

Feasibility of DHM, image quality and need to adjustments in global population and in each subgroup.

Abstract Figure 1