Multi-parametric on board evaluation of right ventricular function using 3D echocardiography: feasibility and accuracy against traditional 2- and 3 dimensional echocardiographic measurements

Authors:
G Tamborini¹, C Cefalu¹, F Celeste¹, L Fusini¹, V Mantegazza¹, M Muratori¹, P Gripari¹, S Ghulam Ali¹, A Garlasche¹, G Berna¹, M Pepi¹, ¹Centro Cardiologico Monzino, IRCCS. - Milan - Italy,

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Background. Three-dimensional echocardiographic (3DE) quantification of right ventricle (RV) has been validated in many clinical settings. However, the necessity of complicated and off-line dedicated softwares has reduced the diffusion of 3DE RV evaluation in daily practice. Recently, a new simplified "on board" 3DE software (OB) has been developed to obtain RV volumes and ejection fraction (EF) together with some of the most used traditional parameters of RV function, automatically derived from 3DE: tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), longitudinal strain (LS).

Purpose The aims of this study were to evaluate the feasibility and accuracy of RV analysis with OB in a large series of patients.

Methods We studied 140 subjects: 35 normals and 105 patients: 26 valvular, 20 coronary artery diseases, 33 idiopathic dilated cardiomyopathy and 26 congenital or acquired pathologies associated with RV pressure or volume overload. Each patient underwent a complete 2DE and 3DE with OB 3DRV evaluation. Results were compared with the conventional off-line software (OFL) and with the traditional two-dimensional echocardiographic (2DE) derived corresponding functional values. A subgroup of 22 patients underwent cardiac CMR and 3DE OB data were compared with CMR RV volumes results.

Results: OB RV reconstruction was feasible in 133/140 cases (95%). Imaging quality was good in most of them (84%). Mean time for 3DE acquisition was 73.8±24 sec, for RV OB reconstruction 97.5±33 sec and for OFL analysis 129±52 sec in addition to the time spent for the RV dataset loading (80±24 sec). No significant differences were observed between OB and OFL 3DE RV volumes and EF. 3DE derived FSA and LS (but not TAPSE, which suffers from suboptimal alignment) were similar to 2DE values and significantly correlated with tissue Doppler systolic peak velocity, RV dP/dt, systolic pulmonary pressure and RV myocardial performance index. Normals were characterized by smaller RV volumes and higher RVEF, FAC, TAPSE and LS in comparison to patients.

In the 22 patients who underwent CMR, OB RV volumes and EF correlated tightly with the CMR values (EDV: r² 0.922, bias -21.5 ml; ESV r² 0.928, bias -6.3 ml; EF r² 0.833, bias -0.8%), likewise OFL RV data (EDV: r² 0.950, bias -18.5 ml; ESV r² = 0.39, bias -7.3 ml; EF r² 0.8689, bias -0.7%)  

Conclusion. This new OB 3DE method is feasible, time saving and accurate in comparison with CMR. It easily provides 3DE RV volumes and ejection fraction and multiple functional parameters including FAC and LS. Off-line operator border adjustment is actually recommended to obtain a more accurate 3DE derived TAPSE (easily obtained by proper alignment).