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Feasibility and accuracy of the automated quantification of two- and three-dimensional left ventricular ejection fraction and its role in the arrhythmic risk stratification of organic heart disease

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BACKGROUND. New automated approaches for left heart chamber quantification based on adaptive analytics algorithms have been introduced for both two- (2DE) and three-dimensional (3DE) echocardiography. These algorithms measure a left ventricular ejection fraction (LVEF) and reduce the intra- and inter-observer variability associated with the conventional manual tracing of LV endocardial borders. However, the clinical utility of these algorithms in the sudden cardiac death (SCD) risk stratification of patients with organic heart disease remains to be clarified.

PURPOSE. We sought to test the feasibility and the accuracy of two automated algorithms that measure 2DE and 3DE LVEF in patients with impaired LV systolic function and to define the cut-off values for fully automated 2DE and 3DE LVEF that could predict major arrhythmic events (MAE). We wanted also to assess the feasibility of replacing manual 2DE and semi-automated (SA) 3DE LVEF with fully-automated (FA) 2DE and 3DE LVEF respectively, in the stratification of high arrhythmic risk patients.

METHODS. We prospectively enrolled 240 patients (63 ± 13 years, 81% men) with both ischemic and non-ischemic cardiomyopathy with 2DE LVEF < 50%, no previous MAE or coronary artery revascularization < 90 days, after at least 3 months of optimal medical therapy for heart failure. MAE were defined as SCD, resuscitated cardiac arrest (CA), ventricular fibrillation, sustained ventricular tachycardia and appropriate ICD shocks. The risk detection cut-off values for 2DE and 3DE FA LVEF were computed using the maximally selected rank statistics method. In order to predict the risk of MAE we created four different risk models, including both clinical characteristics (age, NYHA class, aetiology of the LV dysfunction) and imaging-derived data (2DE manual LVEF, 2DE FA LVEF, 3DE SA LVEF and 3DE FA LVEF), analyzed by a ROC curve.

RESULTS. During a 27 ± 25months follow-up period, 31 patients (13%) presented MAE including SCD (n= 22; 9%), resuscitated CA (n = 3; 1%) and appropriate ICD shocks (n = 6; 2%). Both 2DE and 3DE FA LVEF showed high feasibility (92% and 95%, respectively), and good agreement with conventional LVEF (2DE mean difference 4 ± 7%, and 3DE mean difference 4 ± 7%). We identified two FA LVEF cut-offs for the MAE detection: 2DE <39% (p = 0.006) and 3DE <37% (p = 0.005). The model including the 2DE FA LVEF showed an area under the curve (AUC) larger than the one including conventional 2DE LVEF (0.83 vs 0.80). Conversely, the AUC obtained with FA 3DE LVEF model was slightly lower than the one obtained using SA 3DE LVEF model (0.80 vs 0.84).

CONCLUSIONS. Both 2DE and 3DE FA LVEF are feasible and accurate alternative to the conventional (manual) or SA endocardial border tracing. The use of specific FA 2DE LVEF cut-off values showed a comparable predictive power in the MAE risk stratification compared to the conventional one with the advantage of very low intra- and inter-observer variability.