Relationship between left ventricular longitudinal deformation and clinical heart failure during admission for acute myocardial infarction - a two dimensional speckle tracking study

M Erbsbøll, N Valeur, M.J. Andersen, UM Mogensen, JE Møller, C Hassager, P Segaard, and L Køber
Department of Cardiology, Rigshospitalet, Department of Cardiology, Gentofte Hospital, Denmark

1 Purpose

Modern reperfusion strategies have significantly decreased the loss of viable myocardium associated with acute myocardial infarction (MI). However in-hospital congestive heart failure (HF) still remains a significant predictor of short- and long-term prognosis. Acute HF can develop despite relatively preserved left ventricular ejection fraction and this discrepancy between apparently minor myocardial injury and overt HF is poorly understood. Assessment of left ventricular long axis deformation using echocardiographic speckle tracking allows for quantification of longitudinal fibre function which can be abnormal despite preserved LVEF.

We hypothesized that global longitudinal strain (GLS) to a greater extent than traditional markers of systolic and diastolic function, reflect in hospital HF. Furthermore, we assessed the importance of GLS in relation to in-hospital HF in patients with preserved LVEF.

2 Methods

We consecutively included patients with acute myocardial infarction referred for acute and subacute coronary angiography. Symptoms of heart failure were adjudicated by an independent observer without knowledge of echocardiographic data. In-hospital heart failure was defined as Killip class ≥ 1.

Echocardiography was performed within 48 hours of admission to our institution on a Vivid E9 platform (GE healthcare, Horten, Norway).

Two dimensional speckle tracking was performed on the three standard apical projections and global left ventricular strain (GLS) was calculated. Biplane LVEF was also calculated using Simpsons method. NT-proBNP was sampled after the echocardiographic examination and analyzed on a commercially available assay (Roche Diagnostics, Mannheim, Germany).

The association between GLS and in-hospital HF was assessed in multiple logistic regression analysis with bootstrap validation in 200 randomly regenerated samples. Patients with LVEF>40 were analyzed in a separate model. Model performance was assessed with the C-statistic.

The study population consisted of 611 patients. After excluding patients with atrial fibrillation (n=22) and patients with poor image quality (n=41) a total of 548 patients were included in the analyses. The baseline characteristics are given in table 1.

Global longitudinal strain was significantly impaired in patients with in-hospital HF (n=89,16%), (-14.6 ± 3.3 vs. -10.1 ± 3.5; p<0.0001).

Results

The study population consisted of 611 patients. After excluding patients with atrial fibrillation (n=22) and patients with poor image quality (n=41) a total of 548 patients were included in the analyses. The baseline characteristics are given in table 1.

Global longitudinal strain was significantly impaired in patients with in-hospital HF (n=89,16%), (-14.6 ± 3.3 vs. -10.1 ± 3.5; p<0.0001).

Stepwise multiple logistic regression analysis adjusting for age, 3 vessel disease, LAD involvement, episodes of AF, renal impairment, NT-proBNP, troponin T, LVEF and wall motion score found that GLS was the single most important marker of in-hospital HF (OR 1.47 (1.33-1.62), p<0.0001). GLS was superior to LVEF (C-statistic 0.84 vs. 0.72, p<0.0001). Addition of diastolic dysfunction and log(NT-proBNP) to LVEF did not outperform GLS (C-statistic 0.82 vs. 0.83).

A total of 464 patients (85%) had LVEF >40% of which S3 (11%) experienced in-hospital HF (11.9% vs. -15.1%, 3.0%, p<0.0001). Adjustment for age, episodes of AF, Troponin T level and log(NT-proBNP) revealed that GLS was the single most important marker of in-hospital HF (OR=1.33 (1.14-1.54), p<0.001). Inclusion of GLS rendered log(NT-proBNP) insignificant also in LVEF (Table 3).

Validation of the modelling process in 200 bootstrap samples revealed that GLS was consistently selected for model inclusion (199/200 samples).

4 Conclusion

The results of this study demonstrate that global longitudinal strain is significantly impaired in patients with MI complicated by in-hospital HF. Measurements of global longitudinal strain was superior to LVEF and NT-proBNP in providing information about myocardial dysfunction, suggesting that global longitudinal strain is powerful marker of hemodynamic deterioration in MI.

In patients with preserved LVEF global longitudinal strain provided more information than NT-proBNP in relation to in-hospital HF. Global longitudinal strain could be important in selecting those patients with preserved LVEF at high risk for future events.