

ORIGINAL INVESTIGATION

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Comparison of speckle-tracking echocardiography with invasive hemodynamics for the detection of characteristic cardiac dysfunction in type-1 and type-2 diabetic rat models

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Abstract

Background: Measurement of systolic and diastolic function in animal models is challenging by conventional non-invasive methods. Therefore, we aimed at comparing speckle-tracking echocardiography (STE)-derived parameters to the indices of left ventricular (LV) pressure–volume (PV) analysis to detect cardiac dysfunction in rat models of type-1 (T1DM) and type-2 (T2DM) diabetes mellitus.

Methods: Rat models of T1DM (induced by 60 mg/kg streptozotocin, $n = 8$) and T2DM (32-week-old Zucker Diabetic Fatty rats, $n = 7$) and corresponding control animals ($n = 5$ and $n = 8$, respectively) were compared. Echocardiography and LV PV analysis were performed. LV short-axis recordings were used for STE analysis. Global circumferential strain, peak strain rate values in systole (SrS), isovolumic relaxation (SrIVR) and early diastole (SrE) were measured. LV contractility, active relaxation and stiffness were measured by PV analysis.

Results: In T1DM, contractility and active relaxation were deteriorated to a greater extent compared to T2DM. In contrast, diastolic stiffness was impaired in T2DM. Correspondingly, STE described more severe systolic dysfunction in T1DM. Among diastolic STE parameters, SrIVR was more decreased in T1DM, however, SrE was more reduced in T2DM. In T1DM, SrS correlated with contractility, SrIVR with active relaxation, while in T2DM SrE was related to cardiac stiffness, cardiomyocyte diameter and fibrosis.

Conclusions: Strain and strain rate parameters can be valuable and feasible measures to describe the dynamic changes in contractility, active relaxation and LV stiffness in animal models of T1DM and T2DM. STE corresponds to PV analysis and also correlates with markers of histological myocardial remodeling.

Keywords: Speckle-tracking echocardiography, Invasive hemodynamics, Diabetic cardiomyopathy, Cardiac dysfunction, Heart failure, Murine models, HFpEF, HFrEF

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