Assessment of left ventricular systolic and diastolic function in diabetic rat model using Electrocardiography-gated 18F-FDG PET imaging

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Aim: In this study, we explore the potential of ECG-gated 18F-FDG PET to assess LV systolic and diastolic function in a well-established rat model of type 2 diabetes.

Introduction: Left ventricular (LV) diastolic dysfunction, defined as a disruption of the normal filling pattern of the ventricle but normal systolic function, is one of the early signs of cardiac involvement in diabetic patients.

Methods: List-mode gated 18F-FDG PET imaging was performed on a rat model of type 2 diabetes (ZDF fa/fa) (n = 6) and ZL control rats (n = 6) at age of 13 weeks 15–30 min after tracer-administration (37 MBq) via tail vein under hyperinsulinemic-euglycemic clamp using a dedicated small animal PET system (Siemens Inveon) with ECG signal recording for 20 min. List-mode data were sorted and reconstructed into tomographic images of 16 frames per cardiac cycle. PET images were resized to match human-scale pixels. Left ventricular functional parameters were calculated using standard clinical software program (Heart Function View).

Results: Hyperinsulinemic-euglycemic clamp and post mortem tissue analysis demonstrated the development of diabetes in the ZDF rats and of significant myocardial hypertrophy in ZDF rats at age of 13 weeks (994 ± 78 mg vs. 871 ± 44 mg in ZDF rats vs. ZL controls, p < 0.01, respectively). The PET images analysis showed a mild but significant decrease of LV FR in the ZDF rats (10.4 ± 0.5 vs. 11.8 ± 0.4 EDV/s in ZDF rats vs. ZL controls, p < 0.001, respectively), whereas no significantly differences concerning LVEF and cardiac output (CO) could be detected between model and control rats (LVEF: 60.0 ± 4.5 vs. 63.7 ± 4.1%, p = 0.25 and CO: 90917 ± 14015 vs. 85208 ± 17511 μl/min, p = 0.90, respectively).

Conclusion: In a rat model of type 2 diabetes, we demonstrated the ability of ECG-gated-18F-FDG PET together with a clinical ventricular edge detection software to assess reliable LV systolic and diastolic parameters and to detect the presence of a diastolic dysfunction in the diabetic rats.