Early phenotypes of diabetic cardiomyopathy assessed by multiparametric magnetic resonance imaging and magnetic resonance spectroscopy (1/3)

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OBJECTIVES:

Cardiovascular magnetic resonance (CMR) imaging and spectroscopy (MRS) provide a non-invasive assessment of the functional, structural and metabolic status of the heart. The aim of this study was to assess the early manifestations of diabetic cardiomyopathy using multiparametric CMR and MRS in patients with stable, uncomplicated type 2 diabetes (T2DM), having a short duration of disease (<4 years).

METHODS:

19 patients (mean age 52.6 ±1.8 years) with early-onset (median duration 2 [IQR: 0.5-3] years) T2DM and 18 healthy volunteers with moderately elevated body mass index (BMI) (mean age 52.8 ±2.3 years) and 16 healthy volunteers with normal BMI (mean age 51.3 ±3.5 years) were studied. Patients were either drug naive for diabetic therapy or on metformin monotherapy, HBA1c ≥ 6.4 and ≤8.8%, with no history of coronary artery disease or uncontrolled hypertension. Myocardial lipid content and PCr/ATP ratios were quantified using 1H- and 31P MRS, respectively. CMR included cine, tagging and native T1 mapping at 3.0 T. LV diastology was characterised using echocardiography.

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RESULTS:

Diabetic patients were matched with control groups (Table 1) for age and gender; they were weight matched with the elevated BMI control group. Myocardial energetics were impaired in diabetics when compared to controls with elevated and normal BMI (PCr/ATP ratio: 1.51 ±0.07 vs. 1.79 ±0.10 vs. 1.92 ±0.12, p<0.001) and myocardial lipid content was increased (1.15±0.15 vs. 0.55±0.07 vs. 0.48±0.07% respectively, p=0.002). Peak systolic circumferential strain was reduced in diabetics (-15.4±0.9 vs -19.1±0.7 vs -18.9±0.6, p=0.006), indicating subtle LV dysfunction and diastolic function was impaired in diabetics (mitral in-flow E/A ratio=0.93±0.06 vs. 1.13±0.13 vs. 1.24±0.1, p=0.03), respectively, when compared to elevated and normal BMI controls. Despite the metabolic abnormalities observed in diabetics, there was no difference in native T1 values (as a measure of myocardial fibrosis) between diabetic patients and elevated and normal BMI controls (1192±6.5 vs. 1184±7 vs.1198±12 respectively, p=0.58).

Table 1.
Clinical and Biochemical Charecteristics

Variable	Controls with normal BMI (n=16)	Controls with moderately high BMI (n=18)	Type II Diabetics (n=19)	p value
Clinical				
Age, y	51.3 ±3.5	52.8 ±2	52.6 ±1.8	0.678
Body mass index, kg/m2	21.6 ±0.6	28.2 ±0.6	29.5 ±1.5	<0.001
Diabetes duration, y	-	-	2 IQR (0.5-3)	
Heart rate, bpm	59.8 ±3.4	63.6 ±2.4	68 ±2.8	0.41
Systolic blood pressure, mm Hg	120 ±5	127 ±3	128 ±1.8	0.13
Diastolic blood pressure, mm Hg	73 ±3	73 ±1.8	77 ±1.5	0.26
Biochemical				
Glycated hemoglobin, %	-	-	7.38 ± 0.18	
Insulin	-	-	172 ±65	
CMR Findings				
LVEDV, ml	152 ± 11	152 ± 8.8	133 ± 6.6	0.087
LVESV, ml	50 ± 4.8	44 ± 3.7	39 ± 3.6	0.111
LVEF, %	68 ± 1.4	74 ± 1.7	70 ± 1.9	0.135
LV Wall thickness, mm	8.5 ±0.47	10 ±0.29	10 ±0.4	0.004
LV Mass indexed to BSA, g/m2	55 ±3.4	58.4 ±3.5	62 ±3.1	0.205

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CONCLUSIONS:

Abnormal myocardial energy metabolism, cardiac steatosis, reduced LV strain and diastolic dysfunction are present in uncomplicated T2DM patients with short duration of disease.

CMR is a sensitive, non-invasive tool for assessment of myocardial pathophysiology, and it is helpful in the comprehensive phenotyping and staging of myocardial involvement in diabetes.