Diabetes increases stiffness of live cardiomyocytes measured by Atomic Force Microscopy Nanoindentation

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INTRODUCTION. The prevalence of Diabetes Mellitus (DM) is rapidly growing. It is estimated that globally the number of adults affected with diabetes will increase from 171 million in 2000 to 300 million by 2030 (1). DM is a well-recognized risk factor for developing heart failure. DM induced diastolic Left Ventricular (LV) dysfunction is increasingly recognized as an important morbidity and mortality determinant in heart failure. In patients with DM, high diastolic LV stiffness obstructs LV remodeling after myocardial infarction (2,3). One of the major pathological changes observed in DC is an abnormal intracellular Ca2+ homeostasis, attributed to functional alterations of proteins involved with Ca2+ uptake and efflux (4). MATERIALS AND METHODS. In the present report, live isolated control or diabetic CD1 mice cardiomyocytes stiffness was measured by using the Atomic Force Microscope (AFM) nanoidentation function. Diabetes type I was induced in mice by Streptozotocin administration. RESULTS AND DISCUSSION. Histological images obtained from myocardium of 3 month long diabetic mice showed that the myocardial cells lined up in disorder, cellular nucleus sizes were irregular, and myocardial fibers were fragmented and disordered with interstitial collagen accumulation. A reduction in the expression of SERCA2a Ca2+ pump in Left Ventricle (LV) hearts homogenates obtained from diabetic animals compared to age-matched controls was observed. The mean value (measured by AFM) of the apparent elastic modulus for live diabetic isolated cardiomyocytes was 112% higher than live control ones (91 ± 14 kPa for diabetic and 43 ± 7 kPa for control cardiomyocytes). CONCLUSIONS. These results suggest that live cardiomyocyte material properties were affected by diabetes, causing as a final result stiffer cells very likely contributing to high diastolic LV stiffness, already observed in vivo in some Diabetes Mellitus patients.

Key words: AFM, Diabetes, live cardiomyocyte stiffness

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References.


