Short Communication

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Diastolic Cardiac Deformation Monitoring in T2DM: A Necessary Consideration

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As one of the mainly complication of type 2 diabetes (T2DM), diabetic cardiomyopathy(DCM) has become a high risk factor that affect the patient's prognosis in the future. Whereas because of the asymptomatic cardiac function with preserved ejection fraction in the early stage of the disease, the impairment due to the DCM would be inclinable to be ignored in clinic. Therefore, the on time diagnosis of the cardiac dysfunction in DCM patients is necessary. The sensitive and non-invasive speckle tracking echocardiography (STE) has been demonstrated to be reliable to discover the subclinical cardiac dysfunction in many cardiovascular diseases including T2DM, but the current work was more focused on the systolic cardiac deformation. On the other hand, some evidences showed that in the early stage of this disease, cardiac diastolic deformation also existed. Therefore, the more entire analysis of deformation data in patients both in systole and diastole should be considered.

Diabetic cardiomyopathy (DCM)has been recognized as a serious complication of type-2 diabetes mellitus (T2DM) and is with a prevalence of 12% in T2DM patients [1]. The population of diabetes mellitus is still increasing year after year and it is estimated that there will be about 450 million people with diabetes by 2030 [2]. Hence as one of the major chronic disease worldwide, the effective on time interference and therapeutic strategies on diabetic cardiomyopathy is necessary.

In the current clinical understanding, DCM is defined as the presence of left ventricular (LV) dysfunction in patients with T2DM in the absence of arterial hypertension, coronary artery disease (CAD) or evidence of any other structural cardiac disease [3]. Evidences show that the first stage of DCM is clinically asymptomatic, only presents a characteristic diastolic dysfunction, including the increased ventricular stiffness, left atrial enlargement, and elevated LV end-diastolic pressure [4]. However, the variety of these characteristics in different cases make it difficult to conclude a diagnostic criteria of cardiac dysfunction on the early stage. 2- and/or 3-dimensional speckle tracking echocardiography (2-D/3-D STE) is a technology based on the conception of deformation to evaluate the cardiac function, and the clinical evidences have proved that in the asymptomatic status of the early stage of T2DM, the left ventricular global strain and strain rate decreasing can be detected. In Enomoto's report, it showed that in asymptomatic patients with T2DM, the global radial strain did not differ between control and DM patients. However, global longitudinal and circumferential strain and endocardial area change ratio were lower in patients with DM than in the controls [5]. Tadic's research showed that in all the three directions, that in the longitudinal, radial and circumferential the left ventricular mechanics were entirely impaired in T2DM patients [6]. Albeit the variety, these data showed that the global longitudinal strain (GLS) impaired in the early stage of T2DM patients. However, most of these clinical researches were focused on the monitoring of the systolic function in patients, let alone the only a few information from animal models. Previously Li [7] found that at the age of 16 weeks the left ventricular radial strain and circumferential strain in db/db mice were lower than in control mice, but there was no data of the deformation in LV diastole discussed in their research. In our previous work [8] in a T2DM rat model induced through low-dose of STZ and a rich-fat diet, after 6-weeks of the induction, conventional M-mode echocardiography measurement showed that the LVEF and E/A ration remained unchanged in model rats, but STE assessment showed that the strain rate reduced in some segments in systolic left ventricular in model rats, meantime the LV diastolic global radial and circumferential strain were both decreased, as well the radial global strain rate. These results indicated that the diastolic deformation in the rather early age could be found in the T2DM left ventricular, and there should be more consideration in clinic for the assessment of the deformation in diastole in the patients initially affected by T2DM. Moreover, to evaluate the whole myocardium movement, the analysis of the STE should include the strain and strain rate value in circumferential, radial and longitudinal directions both in systole and diastole. When considering systolic function, longitudinal directional deformation investigation might be more inclinable, because sub endocardial fibers are longitudinally oriented which are the ones more vulnerable too myocardial ischaemia and fibrosis. On the other hand, in the early stage of diabetes, the mainly abnormality in myocardium is metabolic dysfunction, of which the affect is a whole but not partial, thus the deformation

evaluation should consider more than only the systolic longitudinal, just as the evidence of Nakai et al. [9] showed. Moreover, since the sensitivity and the non-invasive advantage of this technology has been turned out by various cardiac diseases, these achievements make an early identification of cardiac dysfunction in T2DM affected people more possible.

Although there have been clinical data confirming the cardiac deformation in the early stage in left ventricular in T2DM patients, the underlying fundamental molecular mechanisms is not very clear. Analysis from clinical data appeared that showed that the 3-D STE global longitudinal was associated with HbA1c independently of LV mass index, but there should be more work for the possible deeper significance. In our model, calcium transient's measurements showed that the cardiac deformation in T2DM rats were associated with the calcium handling damage in cardiomyocytes, and although the calcium pump SERCA2a and its key modulating molecular PLB were remain unchanged, the activity of CaMK II and SIRT1/AMPK depressed. The metabolism remodeling, oxidative stress and calcium homeostasis in myocardium is now be regarded as the mainly contributors causing the cardiomyopathy in disease initially, so that the CaMK II and SIRT1/AMPK depression in T2DM early stage should be participated to the cardiac deformation.

So far, according to the enormous clinical evidences it has become a common sense that in the early stage of T2DM, large proportion of patients would be affected by the diastolic cardiac abnormality. However, due to the complicate phenotype of the presentation and the rather asymptomatic left ventricular ejection fraction, it is difficult to come to the diagnostic criteria or classification from the current conventional evaluation and detection methods. Hence, the sensitive and quantitative approach of STE technology may be probable to achieve this aim, and the assessment of cardiac deformation of patients in diastole ought to be thought about. Considering the present limited data, there should be more abundant clinical studies to carry on, to collect more information from patients and ordinary people for the database establishment. At the same time, the prevention of calcium homeostasis damage and SIRT1/AMPK depression might be one of the target the future interference and therapeutic strategies.

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