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Original Research Article

Effect of type 2 diabetes on the left ventricular diastolic dysfunction in patients with chronic kidney disease, 3 and 4 stages

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ABSTRACT

Introduction: Patients with chronic kidney disease (CKD) and coexisting diabetes mellitus (DM) are likely to have cardiological complications.
Aim: We assessed whether patients with moderate kidney dysfunction, with coexisting type 2 DM and preserved left ventricular (LV) systolic function, demonstrate a more advanced LV diastolic dysfunction.
Material and methods: The study group consisted of 58 ambulatory patients with CKD, stages 3 and 4. The patients were assigned to groups based on the presence of type 2 DM. The first group (DM+) consisted of 21 patients with type 2 DM while second one (DM−) consisted of 37 patients without type 2 DM. Standard echocardiography was performed in all patients with tissue Doppler echocardiography for evaluation of the systolic velocity and both diastolic velocities of LV. The following laboratory parameters were measured: serum creatinine concentration, estimated glomerular filtration rate, and the levels of urea, phosphorus, calcium, parathormone, platelets count, hemoglobin level and N-terminal pro-B-type natriuretic peptide levels. LV diastolic dysfunction was defined as EmLV less than 8 cm/s.
Results and discussion: Patients in DM+ group, as compared to patients in DM− group, were characterized by higher values of left and right ventricular end-diastolic dimension, left atrial diastolic dimension, interventricular septal diastolic diameter, LV posterior wall dimension at diastole and of LV mass index, smaller LV ejection fraction and LV fractional shortening. In tissue Doppler echocardiography patients of DM+ group, as compared to patients of DM− group, did not differ in value of EmLV (7.4 ± 2.4 cm/s vs. 7.6 ± 2.1 cm/s, $P = .723$), respectively, and were characterized by similar estimated LV diastolic filling pressure as indicated by E/EmLV (10.1 ± 3.7 vs. 8.8 ± 2.6, $P = .119$).

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Conclusions: CKD patients in the moderate stage, with coexisting type 2 DM were not characterized by higher risk of developing LV diastolic dysfunction.

1. Introduction

Heart failure with preserved ejection fraction is the most frequent clinical type of heart failure found in patients with chronic kidney disease (CKD),[1,2] whereas cardiovascular complications are the main cause of death in this group of patients.[3–5] Type 2 diabetes mellitus (DM) is a risk factor for cardiovascular complications in the general population, and CKD is also associated with increased cardiovascular morbidity and mortality.[6–11] Consequently, the comorbidity of these two diseases may worsen prognosis for patients. Both type 2 DM and end-stage renal disease (ESRD) can lead to diastolic cardiac dysfunction. Additionally, type 2 DM also contributes to an increased left ventricular (LV) stiffness, which directly affects LV diastolic and systolic function.[12–15] Numerous previous studies with tissue Doppler imaging (TDI) confirmed its efficacy in diagnosing LV diastolic dysfunction.[16–19] The majority of these studies assessed LV diastolic dysfunction in patients with ESRD or type 2 DM, or in dialysis patients with DM.[20–23] However, there are limited reports that assess patients with moderate kidney dysfunction (MKD). We assessed whether patients with MKD, CKD, stages 3 and 4, with coexisting type 2 DM and preserved LV systolic function, demonstrate a more advanced LV diastolic dysfunction.

2. Aim

We assessed whether patients with MKD, with coexisting type 2 DM and preserved LV systolic function, demonstrate a more advanced LV diastolic dysfunction.

3. Material and methods

The study group consisted of 58 ambulatory patients with CKD, stages 3 and 4. The patients were assigned to groups based on the presence of type 2 DM. DM was defined as fasting glucose more than or equal to 7.0 mmol/L or therapy with insulin or hypoglycemic therapy. Insulin therapy was used in the majority of the subjects. Mean reported duration of DM was 6.5 years. The type 2 DM group (DM+) consisted of 21 patients while non-type 2 DM group (DM−) consisted of 37 patients. Inclusion criteria included preserved LV systolic function defined by LV ejection fraction more than 50% and lack of regional wall motion abnormalities, and presence sinus rhythm.[24] Exclusion criteria comprised: non-sinus rhythm, LV systolic dysfunction, previous myocardial infarction, cardiomyopathy, significant valvular heart disease, pericardial fluid more than 10 mm at diastole. Diagnostic criteria for CKD were consistent with the National Kidney Foundation Kidney Disease Outcomes Quality Initiative standards.[25] Body mass index (BMI) was also calculated for each patient.

3.1. *Echocardiography*

3.1.1. *Standard echocardiography*

Standard echocardiography was performed for all patients using a GE 6S device with 2.5–3.5 MHz transducer. In order to increase the credibility of the obtained echocardiographic results, the physician who performed the examination was unaware of the biochemical parameters of the patients. The examinations were conducted in stable patients and particular attention was placed on retaining optimal hydration.

Using the M-MODE in the parasternal long-axis view the following parameters were measured: LV end-diastolic dimension, right ventricular end-diastolic dimension, left atrial diastolic dimension, interventricular septal diastolic diameter and LV posterior wall dimension at diastole. Additionally, LV fractional shortening was assessed. In a four-chamber view LV ejection fraction was calculated with the modified Simpson's rule.[26] LV mass was calculated with the formula recommended by the American Society of Echocardiography modified by Devereux.[27] The obtained results of LV mass were indexed by the body surface area of the patient and presented as LV mass index.

Mitral flow velocities were recorded via a pulsed-wave Doppler with the sample volume placed at the tip of the mitral valve in the apical four-chamber view. The mitral inflow velocity curve yielded the following measurements: peak mitral inflow velocity at early and late diastole and deceleration time of early diastole. Early and late diastole ratio was also calculated.[26]

3.1.2. *Tissue Doppler echocardiography*

Pulsed-wave TDI of the mitral annulus was obtained from the apical four-chamber view immediately after standard echocardiography. In pulsed wave TDI diastolic and systolic velocities were measured by placing the Doppler gate on the lateral mitral annulus at the posterior leaflet of the mitral valve. The following parameters were measured: peak mitral annular systolic velocity, peak early diastolic velocity and peak late diastolic velocity of the lateral part of the examined annulus.[10] Next a combination of transmitral flow velocity with annular velocity was calculated to evaluate and estimate LV filling pressures. Additionally isovolumetric contraction time, isovolumetric relaxation time and ejection time were also measured. Myocardial performance index was calculated as the sum of isovolumetric contraction time and isovolumetric relaxation time divided by ejection time (IVCT + IVRT/ET).[28] All parameters were calculated as the mean of measurements taken in three consecutive cardiac cycles. LV diastolic dysfunction was defined as EmLV less than 8 cm/s.[29]