Assessment of Left Ventricle Diastolic Dysfunction in Chronic Kidney Disease Patients

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Abstract: Cardiovascular disease (CVD) remains the most common aetiology of mortality in chronic kidney disease (CKD). We aimed to assess the prevalence and quantify the relation of left ventricle (LV) diastolic dysfunction and CKD. A Prospective study carried on 100 patients (ages: 20-86 years) with CKD, divided into 4 groups according to their estimated glomerular filtration rate (eGFR): i) Group 1: GFR=60-89 (12 patients), ii) Group 2: GFR=30 – 59 (33 patients), iii) Group 3: GFR=15 – 29 (33 patients) and iv) Group 4: GFR < 15 or on dialysis (22 patients) and 20 healthy subjects (ages: 50-75 years) as control group referred to our department for routine evaluation during the period from October 2017 to June 2018. We performed conventional pulsed wave Doppler (cPWD) echocardiography and tissue Doppler imaging (TDI) to all patients. We reported significant prevalence of grade II & III LV diastolic dysfunction among group 3 and 4 CKD patients (p<0.001), concerning correlation between GFR and echocardiographic parameters in the study population; there was significant direct correlation between GFR and E/MED E’ (R: 0.42; P<0.001) and Lat E’ (R: 0.30; P=0.001), While there was significant inverse correlation between GFR and LA size (R: -0.21; P=0.018), E/A (R: -0.19; P=0.029), E (R: -0.49; P<0.001), E/LAT E'(R: -0.53; P<0.001) and grades of diastolic dysfunction (R: -0.54; P<0.001). In conclusion: LV diastolic dysfunction is strongly associated and directly related to chronic kidney disease grades.

Keywords: Chronic Kidney Disease, Left Ventricle Diastolic Dysfunction, Tissue Doppler Imaging

1. Introduction

Diastolic function is an important element of cardiac function. The ventricle must fill properly to eject enough stroke volume, required by the body [1].

In the past, heart failure with preserved Ejection Fraction (HFpEF) was known as Diastolic heart failure. Although, this term was proved to be inaccurate, as the physiological abnormalities are not only restricted to Diastole [2].

The most important component sharing in diastolic dysfunction are left ventricular diastolic stiffness and left ventricular relaxation impairment [3].

Diastolic function can be evaluated through laboratory measures (BNP and NT pro BNP), invasive methods (Catheterization) and non-invasive methods (Echocardiography) [4].

The evaluation of left ventricular diastolic function non-invasively has become increasingly important for many reasons: i) early detection and assessment of the severity of impairment of active relaxation may lead to application of preventive measures to delay or avoid the occurrence of clinical heart failure [5], ii) Diastolic dysfunction may point the earliest manifestation of myocardial ischemia, iii) In addition, diastolic dysfunction accounts for 44 percent of hypertensive, diabetic, obese subjects [6].

Echocardiography is considered the method of choice when evaluating left ventricular diastolic function [7].

Finally, the European-working group defines HFpEF as: a- Symptoms and signs of congestive heart failure, b- Left ventricular ejection fraction (LVEF) > 50% and non-dilated left ventricle less than 97ml/m2, c- Evidence of increased left ventricular filling pressure; either: 1- Pulmonary capillary wedge pressure (PCWP) more than 12 mmHg or left ventricular end diastolic pressure more than 16 mmHg, 2- E/e' > 15, 3- E/e' > 8 but < 15 and a positive B natriuretic peptide BNP > 200 pg /ml or NT-BNP > 220 pg /ml [8].

Conventional risk factors are highly prevalent in patients with chronic kidney disease (CKD) and subsequently those
patients are closely related to accelerated atherosclerosis, left ventricular (LV) dilatation with hypertrophy, systolic dysfunction, and high LV filling pressure [9].

Our study aimed to assess the prevalence and quantify the relation of LV diastolic dysfunction in CKD patients.

2. Materials and Methods

2.1. Data Analysis

We obtained analyzed data in this prospective observational comparative study from patients with CKD and normal healthy subjects who came to cardiology department Mansoura University for routine evaluation during the period from October 2017 to June 2018 after approval of the local ethical committee of Faculty of Medicine, Mansoura University.

The diagnosis of CKD was based on criteria of structural or functional kidney abnormalities (abnormal urine analysis or imaging studies) that persist for at least three months, with or without a decreased glomerular filtration rate (GFR) (as defined by a GFR of less than 60 mL/min per 1.73 m²) according to the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF/KDOQI) working group definition [10].

The following patients are excluded from our study: ischemic heart disease, congenital heart disease, valvular heart disease, primary myocardial disease, reduced EF; < 50% and chronic obstructive lung disease patients.

After considering the exclusion criteria, the number of patients remain is 100 CKD patients (Age 20-86 years) who were divided according to GFR estimated by Cockcroft-gault equation of creatinine clearance into 4 groups as test groups: i) Group 1: GFR=60-89 (12 patients), ii) Group 2: GFR=30 – 59 (33 patients), iii) Group 3: GFR=15 – 29 (33 patients), iv) Group 4: GFR < 15 or on dialysis (22 patients) in addition to 20 healthy subjects (ages: 50-75 years) as control group.

We subjected patients who met the inclusion criteria and gave informed consent to participate in the study to.

2.2. Full History Taking

With emphasis on cardiovascular disease risk factors as hypertension, Diabetes, dyslipidemia, cigarette smoking; Hypertension was defined according to Eighth Joint National Committee (JNC8) as persistent elevation of resting systolic blood pressure more than 140 mmHg, diastolic blood pressure more than 90 mm Hg, or current compliance on medications lowering blood pressure [11]. Diabetes was defined by prior diagnosis with current antidiabetic medications. Criteria for the diagnosis of diabetes according to American Diabetes Association (ADA) include any of the following: i) A hemoglobin A1C (HbA1c) level of ≥ 6.5%; ii) A fasting plasma glucose (FPG) level ≥ 126 mg/dL; iii) 2-h plasma glucose ≥ 200 mg/dL during an oral glucose tolerance test (OGTT). iv) A random plasma glucose ≥ 200 mg/dL in a patient with classic symptoms of hyperglycemia [12]. Dyslipidemia was defined by prior diagnosis with current cholesterol-lowering medications, or fasting serum cholesterol, low density lipoprotein (LDL) and high density lipoprotein (HDL) cholesterol, triglycerides levels were >200 mg/dL, > 100mg/dl and <40 mg/dl, >150 mg/dl respectively [13] and Smokers were defined as current smokers, and ex-smokers were defined as patients whom quiet smoking more than 6 months.

2.3. Clinical Examination

With emphasis on pulse, blood pressure, neck veins, basal lung crepitation and local cardiac examination.

2.4. Biochemical Assessment

With emphasis on Blood glucose, serum creatinine, complete blood count (CBC), INR and urine analysis values of each patient were recorded.

2.5. 12 Lead Surface ECG

Done for all included patients.

2.6. Echocardiography

Patients attained the left lateral decubitus position and imaged using a commercially available system General Electric Vivid E9 XD clear Dimensions ultrasound system (GE Healthcare, USA) using the M5Sc transducer, Images were attained simultaneously with ECG signal recorded.

Conventional echo study: 2D images were attained during breath hold and saved in cine-loop format from three consecutive beats, 2D guided M-Mode and Doppler echocardiography technique (pulsed wave) were done and images were obtained in different views [apical views - parasternal long axis - parasternal short axis].

M-mode & 2-D echo: For assessment left ventricle internal dimensions (LVIDs); {End systolic dimension (ESD); Normal: 47.86±4.3 mm & End diastolic dimension (EDD); Normal: 36.48±4.81} Fractional shortening (FS); Normal: 36.48±4.81 [14]. The references for measured values were according to European society of cardiology.

Pulsed-wave Doppler echo: By using pulsed wave (PW) on mitral valve, the following were measured in 10 consecutive cycles and mean was calculated: 1) E wave: peak E wave, is measured by placing a 2 mm sample volume on mitral leaflet tip in apical-4 chamber view; 2) A wave: peak A wave, is measured by placing a 2 mm sample volume on mitral leaflet tip in apical-4 chamber view; 3) Trans-mitral deceleration time (E-DT): It is the time for peak E velocity to turn back to baseline; In normal, the value range between 160-260 msec and 4) Isovolumic relaxation time (IVRT): It is the time between aortic valve opening and mitral valve closure. It is measured by placing pulsed wave Doppler in left ventricular outflow tract close to anterior mitral valve leaflet to record both velocities in apical view; 60-100 msec is considered normal [15].

Tissue Doppler Imaging: It is done by placing a 5 mm sample volume over lateral mitral annulus then the aliasing velocity should be advanced to 20 cm/sec for signal
Optimization (16), from tissue Doppler imaging (TDI), the following were obtained: 1) E' wave: Reflect rate of myocardial relaxation. It is better than trans-mitral E velocity as it is preload independent and not affected by left atrial pressure (LAP). Value ≥ 8 cm/sec represents normal relaxation and value < 8 cm/sec represent impaired relaxation (4). 2) E/e' ratio: It reflects filling pressure, values i) < 8 reflects normal PCWP and normal diastolic function, ii) > 15 using lateral annulus reflects increased PCWP and abnormal diastolic function [15] and iii) 8 - 15 must be evaluated by other Echo parameters.

Generally, normal young individuals with normal cardiac diastolic function have normal E/A ratio > 1, IVRT < 100 msec, DT=160 – 260 msec, pulmonary S/D ratio > 1, pulmonary Atrial reversal wave (AR) < 35 cm/sec, tissue Doppler mitral annular velocity (E') > 8 cm/sec, E/e' < 8 [4].

Stages of cardiac diastolic dysfunction

I) Stage I (Impaired relaxation): Characterized by E/A ratio less than 1, prolonged IVRT more than 100 msec, prolongation of DT slope more than 260 msec, normal pulmonary venous S/D ratio, TDIE' less than 8 cm/sec, E/e' ratio more than 15 at rest or with exercise [15].

II) Stage II (Pseudo normal Filling pattern): trans mitral flow pattern (E/A ratio, DT, IVRT) return to normal values, pseudo normal pattern can be differentiated by: i) suspicion of the condition; normal trans mitral flow in the setting of LVH or systolic dysfunction is mostly pseudo normal, ii) estimate left atrial size followed by estimation of filling pressure (E/e'), iii) only in case of systolic dysfunction; effect of Valsalva maneuver, blunting of pulmonary venous S wave and the flow propagation velocity less than 50 cm/sec [15].

III) Stage III/IV (Restrictive pattern): Characterized by marked increase in E velocity, E/A ratio more than 2, short DT time less than 150 msec, short IVRT more than 70 msec [15], the systolic forward flow velocity in pulmonary vein is decreased due to increased LAP and decreased compliance of left atrial. Tissue Doppler E' is less than 8 cm/sec with E/e' ratio more than 15 [16], the presence of reversibility (reverse the filling pattern to grade 1 or 2 dysfunctions with Valsalva maneuver or after diuresis) and IV) Stage IV/IV (Restrictive pattern): Failure of reversal means grade IV dysfunction [17].

2.7. Statistical Analysis

Data management and statistical analysis were performed using Statistical Package for Social Sciences (SPSS) vs. 21. Numerical data were summarized using means and standard deviations and ranges. Categorical data were summarized as numbers and percentages. Comparisons between the 4 groups with respect to normally distributed numeric variables were done using the t-test. For categorical variables, differences were analyzed with χ2 (chi square) test and Fisher’s exact test when appropriate.

Pearson Correlation between variables was done, “r” (Pearson correlation coefficient) ranges from +1 to -1. A value of 0 indicates that there is no association between the two variables; a value greater than 0 indicates a positive association; a value less than 0 indicates a negative association.

Level of significance

For all above mentioned statistical tests done, the threshold of significance is fixed at 5% level (p-value). The results were considered: Non-significant when the probability of error is more than 5% (p > 0.05), Significant when the probability of error is less than 5% (p ≤ 0.05), highly significant when the probability of error is less than 0.1% (p ≤ 0.001); the smaller the p-value obtained, the more significant are the results.

Table 1. Distribution of the study population regarding GFR group.

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>χ²</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>12</td>
<td>33</td>
<td>33</td>
<td>22</td>
<td>12.2</td>
<td>0.007*</td>
</tr>
<tr>
<td>%</td>
<td>12%</td>
<td>33%</td>
<td>33%</td>
<td>22%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ²: chi square test; *: significant p <0.05; No: number; %: percent.

The baseline demographic characteristics and risk factors of the studied groups are listed in Table 2. We observed high significant difference between the five groups regarding age (P < 0.001) while there was no significant difference regarding sex distribution (P=0.385) (Table 2)

Table 2. Baseline demographic data and risk factors of the study population among five groups.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (No=12)</th>
<th>Group 2 (No=33)</th>
<th>Group 3 (No=33)</th>
<th>Group 4 (No=22)</th>
<th>Control (No=20)</th>
<th>Significance test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>51.4±15.1</td>
<td>61.1±9.6</td>
<td>68.6</td>
<td>75.3±8.3</td>
<td>62.5±12.5</td>
<td>F=16.4</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Sex</td>
<td>Mean±SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>50%</td>
<td>58.8%</td>
<td>54.5%</td>
<td>45.5%</td>
<td>44.5%</td>
<td>χ² = 4.2</td>
<td>0.385</td>
</tr>
<tr>
<td>Female (%)</td>
<td>50%</td>
<td>41.2%</td>
<td>45.5%</td>
<td>55.5%</td>
<td>55.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>45.1%</td>
<td>54.5%</td>
<td>51.5%</td>
<td>72.7%</td>
<td>20%</td>
<td>χ² = 12.4</td>
<td>0.014*</td>
</tr>
<tr>
<td>Tobacco use (%)</td>
<td>50%</td>
<td>54.5%</td>
<td>20%</td>
<td>44.5%</td>
<td>15%</td>
<td>χ² = 17.3</td>
<td>0.002*</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>40%</td>
<td>35.5%</td>
<td>45.5%</td>
<td>30%</td>
<td>35%</td>
<td>χ² = 19.1</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>22.3±3.1</td>
<td>23.5±3.6</td>
<td>23.5±3.6</td>
<td>23.5±3.6</td>
<td>23.5±3.6</td>
<td>F=12</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

χ²: chi square test; F: Fisher exact test; *: significant p <0.05; No: number; SD: standard deviation; BMI: body mass index.
3. Results

During the study period 100 consecutive patients with CKD referred to us for routine evaluation were divided according to GFR into 4 groups as test groups: i) Group 1: GFR=60-89 (12 patients), ii) Group 2: GFR=30 – 59 (33 patients), iii) Group 3: GFR=15 – 29 (33 patients), iv) Group 4: GFR < 15 or on dialysis (22 patients) in addition to 20 healthy subjects as control group (Table 1).

There were significant differences between the studied groups as regard DM, smoking, hypertension and increased body mass index (BMI): These risk factors were more identified in CKD patient groups compared to control group with more prevalence in groups 3 & 4 patients respectively, grade III diastolic dysfunction accounts for 3.1% & 18.2% of groups 3 & 4 (P < 0.001), grade II diastolic dysfunction accounts for 18.2% & 40.9% of groups 3 & 4 patients respectively, grade III diastolic dysfunction accounts for 3.1% & 18.2% of groups 3 & 4 patients respectively and no reported cases of grades II & III diastolic dysfunction which was significant direct correlation between GFR and E/MED and LA size which is more dilated in groups 3 & 4 versus groups 1, 2 and control group (4.11 & 3.98 versus 3.69, 3.77 and 3.61 respectively; P=0.002), DT time which is more prolonged in groups 2 & 3 versus groups 1, 4 and control (236.5 & 228.2 versus 190.2, 196 and 187.9 respectively; P=0.0001), E/A which was less than 1 in groups 2, 3 and control versus more than 1 in groups 1 & 4 (0.84, 0.91 and 0.82 versus 1.01 & 1.32 respectively; P=0.0001), E (P=0.0001), MED E' which was significantly reduced in group 4 versus groups 1, 2, 3 and control (0.08 versus 0.09, 0.09, 0.09 and 1.11 respectively; P=0.001), E/MED E' which was more significantly increased in group 4 when compared to groups 1, 2, 3 and control (12.3 versus 6.86, 7.74, 8.65 and 7.5 respectively; P=0.0001), Lat E' which was significantly reduced in group 4 versus groups 1, 2, 3 and control (0.08 versus 0.1, 0.1, 0.1 and 0.11 respectively; P=0.001), EF (P=0.021) and E/LAT E' which was more significantly increased in group 4 when compared to groups 1, 2, 3 and control (12.1 versus 5.8, 7.2, 7.9 and 6.9 respectively; P=0.0001) (Table 3).

### Table 3. Echocardiographic parameters among five groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>EF (%)</th>
<th>LA size</th>
<th>DT time</th>
<th>E/A</th>
<th>E</th>
<th>MED E'</th>
<th>E/MED E'</th>
<th>LAT E'</th>
<th>E/LAT E'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (No=12)</td>
<td>Mean±SD</td>
<td>Range</td>
<td>Mean±SD</td>
<td>Range</td>
<td>Mean±SD</td>
<td>Range</td>
<td>Mean±SD</td>
<td>Range</td>
<td>Mean±SD</td>
</tr>
<tr>
<td>EF (%)</td>
<td>66.2±6.5</td>
<td>65.2±7</td>
<td>66.4±8.2</td>
<td>52-89</td>
<td>65.8±9.7</td>
<td>50-87</td>
<td>72±5</td>
<td>59-80</td>
<td></td>
</tr>
<tr>
<td>LA size</td>
<td>3.69±0.29</td>
<td>3.77±0.53</td>
<td>4.11±0.51</td>
<td>3.98±0.58</td>
<td>3.61±0.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DT time</td>
<td>190.2±31.2</td>
<td>236.5±52.3</td>
<td>228.2±41.5</td>
<td>196±49.3</td>
<td>187.9±32.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E/A</td>
<td>1.01±0.36</td>
<td>0.84±0.32</td>
<td>0.91±0.29</td>
<td>1.32±0.64</td>
<td>0.82±0.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>0.6±0.14</td>
<td>0.65±0.18</td>
<td>0.75±0.16</td>
<td>0.93±0.17</td>
<td>0.73±0.07</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>MED E'</td>
<td>0.09±0.02</td>
<td>0.09±0.03</td>
<td>0.09±0.02</td>
<td>0.08±0.03</td>
<td>0.11±0.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E/MED E'</td>
<td>6.86±21.1</td>
<td>7.74±34.8</td>
<td>8.65±23.8</td>
<td>12.3±47.1</td>
<td>7.5±2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAT E'</td>
<td>3.63±11.6</td>
<td>2.6±20</td>
<td>4.4±15</td>
<td>6.7±25</td>
<td>4.4±12.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E/LAT E'</td>
<td>0.5±0.02</td>
<td>0.01±0.03</td>
<td>0.01±0.02</td>
<td>0.08±0.02</td>
<td>0.11±0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0.85±0.14</td>
<td>0.05±0.17</td>
<td>0.05±0.15</td>
<td>0.04±0.12</td>
<td>0.08±0.14</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

There was significant difference between the four test groups regarding the grades of diastolic dysfunction which was significantly increased among patients of groups 3 & 4, grade II diastolic dysfunction accounts for 18.2% & 40.9% of groups 3 & 4 patients respectively, grade III diastolic dysfunction accounts for 3.1% & 18.2% of groups 3 & 4 patients respectively and no reported cases of grades II & III diastolic dysfunction in groups 1 & 2 patients (P < 0.001) (Table 4).

### Table 4. Diastolic dysfunction among four groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Diastolic dysfunction</th>
<th>Group 1 (No=12)</th>
<th>Group 2 (No=33)</th>
<th>Group 3 (No=33)</th>
<th>Group 4 (No=22)</th>
<th>χ²</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>6 (50%)</td>
<td>8 (24.2%)</td>
<td>2 (6.1%)</td>
<td>0 (0%)</td>
<td>45.9</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
<tr>
<td>Grade I</td>
<td>6 (50%)</td>
<td>25 (75.8%)</td>
<td>24 (72.7%)</td>
<td>9 (40.9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade II</td>
<td>0</td>
<td>0</td>
<td>6 (18.2%)</td>
<td>9 (40.9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade III</td>
<td>0</td>
<td>0</td>
<td>1 (3.1%)</td>
<td>4 (18.2%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ²: chi square test; *: significant p < 0.05; No: number; %: percent.

Concerning correlation between GFR and echocardiographic parameters in the studied patients; there was significant direct correlation between GFR and E/MED E' (R=0.42; P < 0.001) and Lat E' (R=0.30; P=0.001). While there was significant inverse correlation between GFR and LA size (R=-0.21; P < 0.018), E/A (R=-0.19; P=0.029), E
The present study and Victor et al. study.

They found that there was significant difference regarding grades of diastolic dysfunction (R=-0.53; P < 0.001) and grades of diastolic dysfunction (R=-0.54; P < 0.001) (Table 5).

Table 5. Correlation between GFR and echocardiographic parameters in the CKD patients.

<table>
<thead>
<tr>
<th>Variables</th>
<th>GFR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF</td>
<td>-0.01</td>
<td>0.46</td>
</tr>
<tr>
<td>LA size</td>
<td>-0.21</td>
<td>0.018*</td>
</tr>
<tr>
<td>DT time</td>
<td>0.01</td>
<td>0.46</td>
</tr>
<tr>
<td>E/A</td>
<td>-0.19</td>
<td>0.029*</td>
</tr>
<tr>
<td>E</td>
<td>-0.49</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>MED E’</td>
<td>0.13</td>
<td>0.099</td>
</tr>
<tr>
<td>E/MED E’</td>
<td>0.42</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>LAT E’</td>
<td>0.30</td>
<td>0.001*</td>
</tr>
<tr>
<td>E/LAT E’</td>
<td>-0.53</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Diastolic function</td>
<td>-0.54</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

R: Pearson correlation; *: significant p <0.05; EF: ejection fraction; LA: left atrium; DT: deceleration time; MED: medial; LAT: lateral.

4. Discussion

LV diastolic dysfunction is markedly prevalent in renal patients even in absence of valve pathology, coronary artery disease and hypertension [18, 19].

It is a criteria of damage to the myocardium before heart failure becomes clinically apparent [20].

The conventional PWD echocardiography depends on multiple factors that make this way inaccurate for diastolic dysfunction diagnosis. TDI is a non-invasive cardiac imaging technique, more independent to the loading conditions [21].

We divided the studied population according to GFR into 4 groups; I) Group1: GFR 60-90 mL/min/1.73 m2, II) Group 2: GFR 30-60 mL/min/1.73 m2, III) Group 3: GFR 15-29 mL/min/1.73 m2, and IV) Group 4: GFR <15 mL/min/1.73 m2 in addition to 20 healthy subjects (control group) (Table 1).

This study aimed to assess the prevalence of LV diastolic dysfunction in chronic kidney patients and to quantify the relation of LV diastolic dysfunction and CKD.

We reported high significant difference between the five groups regarding age while there was no significant difference regarding sex distribution (Table 2).

This was similar to Ahmed Farshid et al. 2013, who noted that diastolic function is a strong predictor of mortality in patients with CKD. They found that there was significant difference regarding age and reported no significant difference regarding sex distribution [22].

In contrast to Victor BM & Barron JT 2010 who studied diastolic heart failure versus diastolic dysfunction in chronic kidney patients. They noted no significant difference regarding age or sex distribution [23].

This could be explained by different sample size in the present study and Victor et al. study.

In our study there was no significant difference regarding hypercholesterolemia, while there was significant difference regarding smoking, diabetes, hypertension and BMI (Table 2).

This was similar to Otsuka et al. 2009, who studied LV diastolic dysfunction in the early stage of CKD. This study found that no significant difference between CKD and non-CKD patients regarding hypercholesterolemia [24].

This was similar to Victor BM & Barron JT. 2010 who found that there was significant difference regarding BMI [23].

In contrast to Ahmed Farshid et al. 2013, they found that there was no significant difference regarding DM [22].

This could be explained by different sample size of diabetic patient in the present study and Ahmed Farshid et al.

In the current study there was significant difference between five groups regarding LA size, DT time, E/A, E, MED E’, E/MED E’, Lat E’, EF and E/LAT E’ (Table 3).

This was similar to Kim et al. (2013) who studied 186 patients with CKD obtaining TDI, they found that there was significant difference regarding E/e’ ratio which correlated with cardiovascular event [25].

Also Takenori et al., who studied LV diastolic dysfunction in the early stage of CKD. There was significant difference between CKD and non-CKD patients regarding DT time, E/A, E, MED E’, E/MED E’, Lat E’ and E/LAT E’, on the other hand they disagreed with us as there was no significant difference regarding ejection fraction [24].

In the current study, comparison of the GFR groups regarding grades of diastolic dysfunction; there was high significant difference between four groups as grades of diastolic dysfunction was increased among patients of group 3 and group 4 (Table 4).

This was similar to Ahmed Farshid et al. 2013, who found that there was correlation between cardiovascular disease with advanced CKD [22].

The limitations in our study included i) A relatively limited number of patients were included in this study and this was responsible for some results being statistically non-significant, ii) The coronary artery disease (CAD) was ruled out only according to history, physical examination, ECG and echocardiography. More sensitive methods like stress tests, CT angiography and conventional angiography were not performed, so may be some CAD patients were inadvertently included in the study.

5. Conclusion

LV diastolic dysfunction is an indicator of damage to the myocardium before heart failure becomes clinically apparent.

LV diastolic dysfunction accompanies patients with CKD and there is a strong association between grades of LV diastolic dysfunction and grades of chronic kidney disease.

So all renal patients should undergo a routine echocardiography, putting in consideration that TDI is a very useful tool to un-mask the LV diastolic dysfunction.

We recommend for more trials on larger sections of CKD patients with new imaging techniques and other parameters for more accurate assessment of LV diastolic function.
References


