Frequency of Left Ventricle Diastolic Dysfunction in Asymptomatic Type II Diabetic Patients

MAHAM NASIR\(^1\), SYED NAJAM HYDER\(^2\), ALI HASSAN\(^3\)

**ABSTRACT**

**Aim:** To find the frequency of left ventricular diastolic dysfunction in patients with diabetes on Doppler echocardiography by measuring their early to late diastolic mitral inflow velocity (E/A ratio) and deceleration time (DT) on Pulse Wave (PW) Doppler and E’ velocity on tissue volume imaging (TVI).

**Methods:** A sample of 97 asymptomatic patients, male and female, was taken from Department of Cardiology in Punjab Institute of Cardiology and Gulab Devi Hospital, Lahore from August 2015 to October 2015 by direct personal navigation method to collect data through Performa.

**Results:** Out of 97 patients, 54 (55.7%) patients presented with Grade I diastolic dysfunction, 6 (6.2%) patients presented with Grade II diastolic dysfunction and 11 (11.3%) patients presented with Grade III diastolic dysfunction. Patients with Grade I diastolic dysfunction had mean E/A ratio of 0.81, deceleration time (DT) 209.4 ms (p ≤ 0.05) and E’ velocity 5.74 m/s (p ≤ 0.05). Patients with Grade II diastolic dysfunction had mean E/A ratio of 1.08, deceleration time 128.8 ms and E’ velocity 4.9 m/s. Patients with Grade III diastolic dysfunction had mean E/A ratio of 1.54, deceleration time 155 ms and E’ velocity 4.9 m/s.

**Conclusion:** It is concluded that Diastolic dysfunction is significantly associated with diabetes mellitus. Echocardiography is valuable for diagnosis of left ventricular diastolic dysfunction. It should be routinely advice in every patient with diabetes along with other parameters for control of diabetes.

**Keywords:** Left Ventricle Diastolic Dysfunction, Type II Diabetes Mellitus, Deceleration Time, Pulse Waves Doppler and Tissue Volume Imaging (TVI) parameters in normal functioning heart are:

- E wave taller than A wave.
- E/A ratio greater than 1.0.
- DT = 160ms-200ms.
- E’ greater than 8.0 ms\(^4,5\).

Aging, obesity, diabetes mellitus, cardiac ischemia, increase in blood pressure, aortic stenosis, myocardial diseases, endomyocardial disorders, pericardial effusion and constrictive pericarditis are various common causes of left ventricular diastolic dysfunction\(^6,7\).

It is difficult to differentiate diastolic and systolic heart failure based on physical findings alone\(^7\). Patients with diastolic dysfunction usually present with Fatigue, Jugular venous distension, exertional dyspnea, Orthopnea, tachycardia, 3\(^{rd}\) and 4\(^{th}\) heart sounds and Nocturnal dyspnea\(^8\).

Echocardiography, Magnetic Resonance Imaging (MRI), Cardiac catheterization and Cardiac scintigraphy are various imaging modalities for diagnosing left ventricle diastolic dysfunction\(^8\). Today, 2-D echocardiography with Doppler is the best noninvasive modality to confirm the diagnosis of left ventricular diastolic dysfunction\(^10\). The evaluation of diastolic function, with additional performance of tissue Doppler and of coronary micro vascular function by trans-thoracic coronary flow reserve
should be done by Doppler echocardiography in diabetic patient\textsuperscript{11}.

Cardiac catheterization and mainly echocardiography first demonstrated the abnormalities in performance of heart in diabetic patients. There is need for further study using more refined techniques for the evaluation of diastolic function and for the relation of diabetes mellitus to a specific cardiomyopathy\textsuperscript{12}.

The frequency of diabetes mellitus is greatly increasing in the world\textsuperscript{13}. 40% of patients with diabetes present with diastolic dysfunction\textsuperscript{14,15}. Prevalence of diabetes in adults worldwide was estimated to be 4% in 1995 and to rise to 5.4% by the year 2025. There will be a 42% increase in diabetic patients in the developed countries and 70% increase in the developing countries by the year 2025\textsuperscript{16,17}.

MATERIALS AND METHODS

A cross sectional study was conducted in Punjab Institute of Cardiology and Gulab Devi Hospital, Lahore, in 2015. This study involved a total of 97 cases of asymptomatic type II diabetic patients with preserved ejection fraction and normal systolic function after assessing by senior cardiologist through echocardiography. Asymptomatic patients with no pulmonary edema or other complications of diabetes mellitus were included. All patients with type II diabetes with ischemic and hypertensive heart disease were excluded from the study.

Informed consent was obtained from the patients. Doppler Echo was done in each patient by cardiologist. Ejection fraction was noted in all selected patients. In echocardiography following values was evaluated:

a. Early to late diastolic mitral inflow velocity
b. Deceleration Time (DT)
c. E’ velocity

Decrease in E velocity and rise in A velocity i.e. E/A <1, DT less than 160 or greater than 220 and E’ velocity less than 8 ms were taken as the indication of left ventricular Diastolic dysfunction. Data was be able to analyze by using SPSS version 22. Data was described in terms of frequencies and percentages for categorical variables. Quantitative variables were expressed in the form of mean and standard deviation. Pearson correlation was applied for categorical variables and independent sample Z test was applied for quantitative variables. A p-value < 0.05 was considered as significant.

RESULTS

Ninety seven patients of diabetes Mellitus including 50.5% males and 49.5% females were selected (Fig. 1). Majority of the patients were among 50-59 years of age and covered 35% of study sample, patients above 70 years covered about 11.3% of study sample (Table 1). Majority of the patients had diabetes Mellitus for less than 10 years i.e., 74.2%. There were two cases of diabetes Mellitus over 20 years. There were more female patients than male having diabetes less than 10 years, male subjects predominated with duration more than 10-20 years (Table 2). Grade I diastolic dysfunction was prevalent in age group of 50-59 years, Grade II diastolic dysfunction was dominant in patients from age 60-69 years. Occurrence of diastolic dysfunction increased with the duration of Diabetes and statistically significant (p ≤0.05)(Table 5) (Fig. 3).

![Pie chart of Gender of Patient](image)

Table 1: Distribution of Gender according to age. (n=97)

<table>
<thead>
<tr>
<th>Age(Yrs)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>1</td>
<td>4</td>
<td>5 (5.2%)</td>
</tr>
<tr>
<td>40-49</td>
<td>7</td>
<td>13</td>
<td>20 (20.6%)</td>
</tr>
<tr>
<td>50-59</td>
<td>17</td>
<td>17</td>
<td>34 (35.1%)</td>
</tr>
<tr>
<td>60-69</td>
<td>16</td>
<td>11</td>
<td>27 (27.8%)</td>
</tr>
<tr>
<td>&gt;70</td>
<td>8</td>
<td>3</td>
<td>11 (11.3%)</td>
</tr>
</tbody>
</table>

Table 2: Distribution of gender according to duration of diabetes

<table>
<thead>
<tr>
<th>Duration of diabetes</th>
<th>Male</th>
<th>Female</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 years</td>
<td>33</td>
<td>39</td>
<td>72 (74.2%)</td>
</tr>
<tr>
<td>10-20 years</td>
<td>15</td>
<td>8</td>
<td>23 (23.7%)</td>
</tr>
<tr>
<td>&gt;20 years</td>
<td>1</td>
<td>1</td>
<td>2 (2.06%)</td>
</tr>
</tbody>
</table>

Table 3: Descriptive statistics of Doppler Measurement

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>E/A ratio</td>
<td>1.0865</td>
<td>0.56</td>
</tr>
<tr>
<td>E’ velocity (m/s)</td>
<td>7.3835</td>
<td>3.04</td>
</tr>
<tr>
<td>Deceleration time (ms)</td>
<td>191.5258</td>
<td>37.86</td>
</tr>
</tbody>
</table>

Table 4: Crosstab of Doppler parameters and left ventricle diastolic dysfunction.

<table>
<thead>
<tr>
<th>Left Ventricle Diastolic Dysfunction</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>0.81</td>
</tr>
<tr>
<td>Grade II</td>
<td>1.08</td>
</tr>
<tr>
<td>Grade III</td>
<td>1.54</td>
</tr>
</tbody>
</table>

Fig. 1: Pie chart of Gender of Patient
Table 5: Correlation of diabetes duration with left ventricle diastolic dysfunction

<table>
<thead>
<tr>
<th>LV diastolic dysfunction</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>26</td>
<td>4.5</td>
<td>3.52</td>
</tr>
<tr>
<td>Grade I</td>
<td>54</td>
<td>7.5</td>
<td>5.29</td>
</tr>
<tr>
<td>Grade II</td>
<td>6</td>
<td>6.5</td>
<td>4.85</td>
</tr>
<tr>
<td>Grade III</td>
<td>11</td>
<td>10</td>
<td>6.08</td>
</tr>
</tbody>
</table>

Correlation: 0.291, P value: 0.004

There was significant variations in E/A ratio, DT and E velocity in patients with diastolic dysfunction. Mean±S.D of the ratio of early to late diastolic mitral inflow velocity (E/A) measured on doppler echo was 1.08±0.56, deceleration time (DT) was 191.5±37.8 and E’ velocity measured on TVI was 7.38±3.04 (Table 3). Patients with Grade I diastolic dysfunction had mean E/A ratio of 0.81, DT 209.4 ms and E’ velocity 5.74 m/s. Patients with Grade II diastolic dysfunction had mean E/A ratio of 1.08, DT 128.8 ms and E’ velocity 4.9 m/s. Patients with Grade III diastolic dysfunction had mean E/A ratio of 1.54, DT 155 ms and E’ velocity 4.9 m/s (Table 4).

**DISCUSSION**

In our study diastolic dysfunction was found in 73.1% subjects. Patil and Burji conducted a study in India which involved 50 patients having type 2 diabetes mellitus without any sign of cardiovascular involvement and diastolic dysfunction was present in 64% patients. Dikshit et al prospectively studied 50 diabetics at outdoor department of New Civil Hospital, Surat and 66% patients had diastolic dysfunction.

Our study revealed that majority of the patients had diabetes for less than 10 years, while their age ranges from 50-59 years and Grade I diastolic dysfunction. It is assumed as the duration of diabetes increases the chances of other related diseases like hypertension, ischemic heart disease increases which were excluded in this study, therefore patients with diabetes more than 20 years were less. Similarly, most of the subjects in Patil and Burji’s study had diabetes less than 5 years and age were between 50-59 years. Whereas in Dikshit et al study,
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the average age of patients with diabetes was 43.88±13.74 years.19

The diastolic dysfunction in our study was assessed by Doppler echocardiography. The patients with E/A ratio < 1 were considered to have diastolic dysfunction. The mean E/A ratio was 1.08±0.56 among the patient who had diastolic dysfunction and statistically it was not significant (p ≥ 0.05). The results of Dikshit et al., study also showed reduced E/A ratio (p<0.05) and prolonged isovolumic relaxation and deceleration times (p < 0.05) in diabetic patients. In Patil and Burji’s study mean E/A ratio was 0.72± 0.24 among the patient who had diastolic dysfunction and it was significant (P ≤ 0.05).

In another study Patil et al33 found out the incidence of LV diastolic dysfunction in diabetic patient and its relation to age, duration of diabetes mellitus. 54% case and 11% healthy subjects had diastolic dysfunction. Patients with diabetic duration of 11 to 15 years showed high prevalence of diastolic dysfunction (P < 0.05).

Hameedullah et al., conducted a descriptive study which showed left ventricular diastolic dysfunction was found in 53% patients. There was a high prevalence of asymptomatic left ventricular diastolic dysfunction in normotensive type II diabetic patients.16

CONCLUSION

In diabetes diastolic dysfunction occurred earlier. It is concluded that severity of diastolic dysfunction is significantly associated with diabetes mellitus. Echocardiography is a noninvasive useful modality in diagnosing left ventricular diastolic dysfunction. It must be done regularly for every diabetic patient to evaluate the cardiac function along with other parameters for control of diabetes.

Limitation: During study we face some limitations that this study is conducted in a two center. That’s why it is not appropriate to generalize the data to the other centers. We suggest that data should be collected countywide to generalize the results.

Ethics committee approval: Taking approval through ethical committee of The Children Hospital and Institute of Child Health, Lahore.

Consent form filled after taking consent from mother and father.

Conflicts of interest: No Conflict of interest.

REFERENCES