Research article
Assessment of diastolic dysfunction in controlled and uncontrolled hypertensive patients: A prospective observational study
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ABSTRACT
Introduction and Aim: Hypertension is a significant risk factors for CV system events on its own, and resulting DD. The aim of the study is to demonstrate the effect of hypertension on the LV diastolic dysfunction in controlled and uncontrolled hypertensive patients which helps to predict the CV mortality.

Materials and Methods: The present study included 210 Hypertensive patients in which 105 controlled HTN & 105 uncontrolled HTN (age ranged from 30-70 years) with their evidence of Blood Pressure. By using Tissue Doppler imaging E/A, E/E’ and E’ are measured and TTE, the following parameters are assessed: IVRT, IVCT, Pulmonary venous flow and hepatic vein flow.

Results: Diastolic dysfunction and blood pressure were positively correlated, with degree of diastolic dysfunction increasing along with blood pressure levels. Diastolic dysfunction and controlled hypertension were not correlated, although moderate and severe hypertension and diastolic dysfunction had a direct association.

Conclusion: In the uncontrolled hypertensive groups compared to the controlled hypertensive groups, the diastolic dysfunction was considerably and progressively higher, according to this study. To obtain population-based data on diastolic dysfunction and other confounding factors in our environment, irrespective of blood pressure levels, more research with a greater number of patients is advised.

Keywords: Diastolic dysfunction (DD); left ventricle (LV); hypertension (HTN); coronary artery disease (CAD).

INTRODUCTION
Systemic hypertension (SHTN) is a significant public health issue and a significant contributor to morbidity and mortality (1-3). The cardiac structure will change morphologically and functionally because of uncontrolled blood pressure (BP; 4). The most frequent of these functional changes is diastolic dysfunction (5,6). An important primary cause of heart failure has been identified as left ventricular diastolic dysfunction (7). HF with normal systolic function in patients with SH is known to be caused by left ventricular diastolic dysfunction (LVDD), which is clinically significant (8-10). There are various techniques for determining diastolic dysfunction. The most popular method to assess left ventricular diastolic function by using PWD. However, as rate of cardiac relaxation, volume status, and left atrial pressure are all influences on the mitral inflow velocity profile, it is preferable to have additional variables to complement mitral inflow velocity when assessing diastolic function (11-13). It has been discovered that the pulsed Doppler echocardiography-derived diastolic function parameters which is E/A, E/E’, E’, IVRT, IVCT, pulmonary venous flow and hepatic vein flow and other diastolic function assessment techniques correlate well (14).

METHODS AND MATERIALS
The current study was a prospective observational study conducted in the department of cardiology in CSSH. The IHEC gave their consent to the study. Inclusion Criteria: CAD, CKD, Both Gender, 30 to 70 years. Exclusion criteria: VHD, PE, COPD, Pregnant Women, Patients with poor echo windows. Patients were informed about the trial and given formal consent. In the questionnaire, relevant history was documented. A total 210 hypertensive patients underwent investigations such as systolic BP, Diastolic BP, Echocardiography. All Hypertensive individuals had done PWD echocardiograms. In the department of cardiology in CSSH, where we use vivid S5 GE machine and an ESAOTE machine to do conventional echocardiography PWD, TDI and colour flow imaging. All individuals were imaged while lying in a left lateral decubitus position and using PWD in Apical 4 chamber view to assess the Diastolic Function, as per the ASE standards.

PW Doppler
The precision and accuracy of the diagnostic process used to identify whether systolic or diastolic impairment is found. While myocardial systolic velocity relative to EF, S is a more accurate predictor of systolic function, TDI demonstrates the early diastolic myocardial velocity E’ and E/E’ have the link with LV comfort and adherence metrics. The velocity of the myocardial long axis during systole (S’), early diastole (E’), and late diastole (cm/s) represents the regional LV function.
Deceleration time

Pulse wave doppler is used to estimate the amount of time between the maximal E point and baseline. The time between the early peak inflow velocity and the end of the rapid filling phase is known as the deceleration time.

Isovolumetric relaxation time

It is the period between AV the closure and mitral valve opening. When relaxation is prolonged, the mitral valve opens more slowly and IVRT increases. High atrial pressure causes the MV to open earlier, shortening IVRT. From the perspective of the Apical 5 chamber, pulse wave doppler is employed to measure.

PV Blood flow

Pulmonary venous blood flow velocity can be calculated where the LA and pulmonary veins meet. Normal PV flow consists of systole and diastole, with a brief reversal of flow during atrial contraction. 3 primary parts: an antegrade systolic wave (S) with two peaks (S1 & S2), a diastolic wave (D), and a retrograde wave (Ar).

HV Flow

HV blood flow velocities reflect changes in the right atrium's compliance, volume, and pressure. It is made up of 4 parts: Sr = Systolic flow reversal, Dr = Diastolic flow reversal, S =forward Systolic flow, and D = Forward Diastolic flow.

Statistical analysis

SPSS IBM software version 26 software was used for data analysis. Comparison of diastolic dysfunction were calculated by using chi-square test. The Chi-square test was used to compare difference in categorical variables between two groups.

RESULTS

Among 57% of controlled hypertensive male patients, 8.6% were normal diastolic function, 40% were Grade I DD, 8.6% were Grade II DD. Among 42% of controlled hypertensive female patients, 5.7% were normal diastolic function, 34.2% were Grade I DD, 2.9% were Grade II DD.

<table>
<thead>
<tr>
<th>Diastolic Dysfunction (DD)</th>
<th>Controlled</th>
<th>Uncontrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (%)</td>
<td>Female (%)</td>
</tr>
<tr>
<td>Normal</td>
<td>9 (8.6%)</td>
<td>6 (5.7%)</td>
</tr>
<tr>
<td>Grade I</td>
<td>42 (40%)</td>
<td>36 (34.2%)</td>
</tr>
<tr>
<td>Grade II</td>
<td>9 (8.6%)</td>
<td>3 (2.9%)</td>
</tr>
<tr>
<td>Grade III</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Among 51% of uncontrolled hypertensive male patients, 20% were Grade I DD, 20% were Grade II DD, 11.4% were Grade III DD. Among 48% of uncontrolled hypertensive female patients, 2.9% were normal diastolic function, 8.6% were Grade I DD, 25.7% were Grade II DD, 11.4% were Grade III DD.

Table 1: Patient demography with diastolic dysfunction (DD)
Table 2: Patient distribution as per age with controlled and uncontrolled hypertension

<table>
<thead>
<tr>
<th>Diastolic Dysfunction (DD)</th>
<th>Controlled Hypertension</th>
<th>Uncontrolled Hypertension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 50 years %</td>
<td>50-70 years %</td>
</tr>
<tr>
<td>Normal</td>
<td>12 (11.4%)</td>
<td>3 (2.9%)</td>
</tr>
<tr>
<td>Grade I</td>
<td>12 (11.4%)</td>
<td>48 (45.7%)</td>
</tr>
<tr>
<td>Grade II</td>
<td>0</td>
<td>9 (8.6%)</td>
</tr>
<tr>
<td>Grade III</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Among 50% of Controlled Hypertension, 11.4% in the age < 50 years, 2.9% in the age 50 to 70 years of patients had Normal Diastolic Function. 11.4% in the age < 50 years, 45.7% in the age group of 50 to 70 years and 17.1% in the age >70 years of patients had Grade I DD. 8.6% in the age group of 50 to 70 years and 2.9% in the age >70 years of patients had Grade II DD.

Among 50% of uncontrolled hypertensive patients, 2.9% in the age < 50 years had normal diastolic function. 11.4% in the age < 50 years, 14.3% in the age 50-70 years, 2.9% in the age > 70 years of patients had grade I DD. 5.7% in the age < 50 years, 25.6% in the age 50 to 70 years, and 14.3% in the age >70 years of patients had Grade II DD. 5.7% in the age < 50 years, 8.6% in the age 50 to 70 years, and 8.6% in the age > 70 years of patients had Grade III DD.

Fig. 3: Patient distribution as per age in controlled hypertension

Fig. 4: Patient distribution as per age in uncontrolled hypertension

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Table 3: Patient distribution of DD with and without comorbidities

<table>
<thead>
<tr>
<th>Diastolic Dysfunction (DD)</th>
<th>Controlled</th>
<th></th>
<th>Uncontrolled</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With Comorbidity</td>
<td>Without Comorbidity</td>
<td>With Comorbidity</td>
<td>Without Comorbidity</td>
</tr>
<tr>
<td>Normal</td>
<td>6 (5.7%)</td>
<td>9 (8.6%)</td>
<td>3 (2.9%)</td>
<td>Nil</td>
</tr>
<tr>
<td>Grade I</td>
<td>45 (42.9%)</td>
<td>33 (31.4%)</td>
<td>9 (8.6%)</td>
<td>21 (20%)</td>
</tr>
<tr>
<td>Grade Ii</td>
<td>12 (11.4%)</td>
<td>Nil</td>
<td>Nil</td>
<td>30 (28.6%)</td>
</tr>
<tr>
<td>Grade Iii</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>18 (17.1%)</td>
</tr>
</tbody>
</table>

Fig. 5: Patient distribution of DD with and without comorbidities in controlled hypertension

Among 60% of controlled hypertensive patients with comorbidities, 5.7% had normal diastolic function, 42.9% had Grade I DD, 11.4% had Grade II DD. Among 40% of controlsent hypertensive without comorbidities patients, 8.6% had normal diastolic function, 31.4% had Grade I DD.

Fig. 6: Patient distribution of DD with and without comorbidities in uncontrolled hypertension

Among 57% of uncontrolled hypertensive patients with comorbidities, 2.9% had normal diastolic function, 8.6% had Grade I DD, 28.6% had Grade II DD, 17.1% had Grade III DD. Among 42% of uncontrolled hypertensive patients without comorbidities, 20% had Grade I DD, 17.1% had Grade II DD, 5.7% had Grade III DD.

Table 4: Correlation of DD in controlled and uncontrolled hypertensive patients:

<table>
<thead>
<tr>
<th>Chi-square value</th>
<th>25.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of freedom</td>
<td>3</td>
</tr>
<tr>
<td>Level of significance</td>
<td>5%</td>
</tr>
<tr>
<td>Table value</td>
<td>7.815</td>
</tr>
<tr>
<td>N</td>
<td>210</td>
</tr>
</tbody>
</table>

The chi-square value (25.4) > Table value (7.815) which is statistically significant

LV DD with controlled and uncontrolled HTN patients has positive correlation. Hence there is a significant correlation between LVDD with controlled and uncontrolled HTN patients.

DISCUSSION

In the current study, 105 controlled hypertensive patients were compared with 105 uncontrolled hypertensive patients from the outpatient clinic at CHRI. Numerous recent studies have established the epidemiological link between diastolic dysfunction and hypertension (15, 16). Increased interstitial fibrosis, increased collagen cross-linking, and disturbed calcium homeostasis in the heart have all been linked to hypertension and may all be factors in the deterioration of diastolic function (17,18). Similar mechanisms most likely contribute to deteriorating vascular function and increased vascular stiffness in hypertension patients (19). The impact of increased...
BP on subclinical LV diastolic function was the key finding. When compared to the normotensive condition, all types of hypertension and prehypertension were considerably more linked to reduced LV diastolic function. Prehypertension triggered the onset of LV diastolic dysfunction and remodelling, which peaked during the uncontrolled hypertensive state through controlled and recently identified hypertension. In addition, all BP and hypertension groups displayed a dose-response connection for echocardiographic measurements of LV diastolic function, with the uncontrolled hypertensive group exhibiting the strongest association. These results suggest that the greatest detrimental consequences of increased BP on the cardiovascular system are in people with uncontrolled hypertension. Additionally, people with managed hypertension had better LV diastolic performance than newly diagnosed or uncontrolled hypertensives (20). Both diastolic dysfunction and abnormalities of vascular function likely contribute to the pathogenesis of HF with preserved EF, and these patients have both abnormalities, even though diastolic dysfunction most likely occurs many years before overt heart failure symptoms appear (21). In patients with HF, DD is a bigger prognostic indicator for mortality than the EF (22, 23). These results imply the therapeutic significance of early detection and effective management of hypertension.

CONCLUSION

Prolonged uncontrolled hypertension leads to diastolic dysfunction. Diastolic dysfunction is a major risk factor of HF. Diastolic HF is characterized by the symptoms and signs of HF, a preserved EF and abnormal LV diastolic function caused by a decreased LV compliance and relaxation. Most patients with HF & preserved EF have a history of HTN. Uncontrolled HTN is irreversible factor of diastolic heart failure compared with controlled hypertensive patients. Diastolic Dysfunction is more prevalent in uncontrolled hypertensive patients compared to those with controlled hypertension. This underscores the importance of strict control of hypertension.

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CONFLICT OF INTEREST

The authors did not state any potential conflicts of interest while conducting their study, writing their paper, or publishing it.

REFERENCES


