

Left Ventricular Diastolic Dysfunction (LVDD) Whether more in Hypertension or Diabetes Mellitus? An Echocardiographic Study

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ABSTRACT

Background: To assess the effect of Hypertension and Diabetes on Left Ventricular Diastolic Function. **Methods:** 2D Echocardiography was performed in 295 subjects. Subjects were divided into two groups – Group 1 having hypertension (HTN) and Group 2 having diabetes mellitus only (DM). Patients with cardiac illness like heart failure, myocardial infarction, arrhythmias were excluded from the study. The procedure was explained and consent was obtained from the patients. All the subjects underwent detail clinical examination. Height, weight, blood pressure, blood sugar, lipid profile, ECG was done. Early peak Diastolic (E) and late peak diastolic (A) transmitral flow were recorded. E/A was calculated. Data are presented as Mean \pm Standard Deviation for continuous variables and as proportions for categorical variables. The X^2 test was used to test differences between proportion. Multiple linear regressions were performed to assess the independent association of hypertension and diabetes with Diastolic function parameters. Differences between Hypertension and Diabetes group were assessed by one way analysis of variance. (Performed using STATA). **Results:** Correlation of hypertension and diabetes with Diastolic function parameters. Diabetes subjects had significantly higher A wave ($P < 0.05$) and lower E/A ratio. No significant differences were observed between hypertension and diabetes groups in any of the Diastolic function parameters. **Conclusions:** Prevalence of Diastolic dysfunction of any grade in both subjects were 58.2% (62.2 in Hypertension and 54.3% in Diabetes).

Key words: Echocardiography, Diabetes, Left Ventricular dysfunction

INTRODUCTION

Diastolic Dysfunction is associated with future occurrence of heart failure, is a predictor of cardiovascular morbidity and mortality in the general population.^[1,2]

Diabetes Mellitus is associated with high morbidity and mortality, mainly because of its association with arterial atherosclerosis and related complications, in particular coronary artery disease and congestive heart failure.^[3-5]

A pseudo-normal diastolic function pattern has been demonstrated in asymptomatic patients with diabetes.^[6] Hypertension and Diabetes often share co morbidities and conditions, like obesity and LV hypertrophy that can impact LV structure and mechanics.^[7,8]

Tissue Doppler imaging (TDI) is newer echocardiograph tool that has been proved more sensitive in the early detection of LV diastolic function alterations than traditional Doppler flow.^[9] TDI provides an estimation of LV diastolic performance that is less dependent on cardiac preload and unlike transmitral flow is not affected by pseudo normalization.^[10,11]

Diastolic dysfunction was defined, according to ASE guidelines and taking into consideration the mean age of our population, as: (i) E/A ratio ≤ 0.7 (impaired relaxation); (ii) E/A ratio > 0.7 and ≤ 1.5 and E0 velocity < 7 cm/s (pseudo-normalized pattern) or (iii) E/A ratio > 1.5 and E' velocity < 7 cm/s (restrictive pattern) (12)

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METHODS

2D Echocardiography was performed in 295 subjects. Subjects were divided into two groups – Group 1 having

hypertension (HTN) where 148 patients were included and in Group 2 having diabetes mellitus only (DM) 147 patients were included in the study. Patients with cardiac illness like heart failure, myocardial infarction, arrhythmias were excluded from the study. The procedure was explained and consent was obtained from the patients. All the subjects underwent detail clinical examination. Heights, weight, blood pressure, blood sugar, lipid profile, ECG were done. Early peak Diastolic (E) and late peak diastolic (A) transmitral flow were recorded. E/A was calculated. Data are presented as Mean \pm Standard Deviation for continuous variables and as proportions for categorical variables. The X^2 test was used to test differences between proportion. Multiple linear regressions were performed to assess the independent association of hypertension and diabetes with Diastolic function parameters. Differences between Hypertension and Diabetes group were assessed by one way analysis of variance. (Performed using STATA)

RESULTS

M Mode:

M mode measurement of left ventricular cavity dimensions. There were no differences between groups in Aortic, IVS (inter-ventricular septum), PW (posterior wall). Transmitral recordings were reported at baseline and after phase 2 of the Valsalva maneuver (to distinguish between pseudo normalized pattern of ventricular filling A wave duration decreases only in subjects with normal diastolic function after the Valsalva maneuver ($P < 0.001$)). No subject had echocardiographically detectable regional wall motion abnormalities. All cardiac valves were examined to rule out significant valvular disease.

Table: Diastolic Function Parameters by presence of Hypertension and Diabetes Mellitus.

| Diastolic function parameters | Patients having HTN(n= 148) | Patients having DM(n= 147) |
|-------------------------------|-----------------------------|----------------------------|
| E wave (cm/s) | 69.3(67.4- 71.3) | 72.1(70.1 – 74.2) |
| A wave (cm/s) | 85.4 (83.4 - 86.8) | 91.5*(88.1 - 94.7) |
| E/A Ratio | 0.84(0.82-0.85) | 0.81(0.78 - 0.84) |
| E' wave (cm/s) | 7.3 (7.1 - 7.5) | 7.7 (7.2 - 8.2) |
| E/E' Ratio | 10.4*(9.8 - 11.1) | 9.9 (9.1 - 10.8) |

Standard sets of covariates; Age , BMI , Sex, LV Mass Index , LVEF, HR
* $P < 0.05$.

The proportion of subjects with elevated LVEDP (identified by an E/E' ratio > 15) was greater in HTN as compared to DM. Prevalence of Diastolic dysfunction of any grade was higher in HTN (62.2%) than DM (54.3%).

DISCUSSION

The major finding of this study is that LVDD is much more prevalent in Hypertension than DM who are free of clinically detectable heart disease. The recognition of the pseudo normal pattern is important as it is an intermediary stage between impaired relaxation and restrictive filling and thus is more advanced stage of LVDD.

In retrospective study the mitral E/A ratio has had equal prognostic value compared with left ventricular systolic index (such as EF) reinforcing the importance of screening for asymptomatic LVDD.

Early and accurate detection of LVDD might have therapeutic implications.

Aerobic exercise could beneficially influence diastolic dysfunction.

This study was limited to small group of well characterized secondary subjects to avoid too many confounding variables.

Prevalence of Diastolic dysfunction of any grade was higher in HTN (62.2%) than DM (54.3%).

Diastolic dysfunction is a risk factor for the development of congestive heart failure.^[1,13] We showed that DM and HTN were independently associated with a higher E/E' ratio an index of LVEDP. The finding of higher LVEDP when diabetes and hypertension coexist. Compared with either condition alone could explain in part the additional risk of developing heart failure in patients with both DM and HTN compared with HTN alone.^[4,5]

The exclusion of subjects with evidence of coronary heart disease or with abnormal LV systolic function allowed us to derive important information on the effect of the two most prevalent cardiovascular risk factors on diastolic function at early stage of disease. The proportion of subjects with elevated LVEDP (identified by an E/E' ratio > 15) was greater in HTN as compared to DM. LV mass index was higher in the group with HTN calculated by Devereux formula.^[19] The E/A ratio is strongly dependent on cardiac load and follow U shaped curve in the natural history of LV diastolic dysfunction with a reduction in the earlier stage of dysfunction.^[9,14,15]

In this stage, the relaxation of the LV is delayed and the early diastolic flow (E-wave) becomes slower; therefore, as a compensatory mechanism, the atrial contribution to the LV filling increases, and the E/A ratio decreases (diastolic dysfunction, Stage 1). With the progression of diastolic dysfunction, the increasing pressure gradient between the left atrium and the LV acts as a propelling force, causing an increase in the E-wave velocity. As a consequence, the E/A ratio increase as well, becoming indistinguishable from a normal flow pattern. In this regard, the analysis of other Doppler flow-derived parameters (mitral isovolumic relaxation time and E-wave deceleration time) that are load dependent is not useful for identifying the apparent reversal of the mitral inflow to a normal pattern.^[16,17] (also known as 'pseudo normalization' of the mitral inflow) as actual progression of the Disease (diastolic dysfunction, Stage 2).

CONCLUSION

Prevalence of Diastolic dysfunction of any grade in both subjects were 58.2% (62.2in Hypertension and 54.3% in Diabetes).

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