Correlation of Left Atrial Volume in patients with and without Left Ventricular Hypertrophy (LVH) that have Normotensive Type 2 Diabetes Mellitus

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Abstract

Background: Left atrial volume index (LAVI) is independently associated with cardiovascular disease. Left atrial (LA) enlargement parallels an increase in left ventricular mass (LVM) and diastolic function. This study was designed to determine the effects of type 2 Diabetes Mellitus (DM) on left ventricular mass and particularly LAVI.

Objective: To assess the prevalence of enlarged LAVI in normotensive type 2 diabetic patients and determine the correlation of LA volume in left ventricular hypertrophy (LVH) and non-LVH patients with normotensive type 2 DM.

Methods: 39 patients with a diagnosis of type 2 DM that had normal blood pressure were included in this study. Left ventricle (LV) and LA structure and function were quantified using two dimensional echocardiography (EF, E/E’, E/A, diastolic grading, LA volume, LV mass). LVH was defined if the LVMI was > 131 g/m2 in males and > 100 g/m2 in females. Abnormal LA volume was defined if the LAVI was ≥ 30 ml/m2.

Results: The prevalence of LVH was 25% (10/39). In those with LVH 40% had an enlarged LAVI (4/10). In patients without LVH 13% had an enlarged LAVI (4/29). The prevalence of an enlarged LAVI was 20.5 % (8/39). The calculated statistics for the correlation between LVH and enlarged LAVI had a Kappa value of 0.28.

Conclusions: There was a poor correlation between LVH and enlarged LAVI. An enlarged LAVI shows some correlation with blood pressure and may be predictive of future hypertension.

Keywords: Left atrial volume index, left ventricular mass

Introduction

Patients with non-insulin dependent Diabetes Mellitus (NIDDM) are characterized by excessive cardiovascular morbidity and mortality (1-2). A previous study showed that left ventricular hypertrophy (LVH) is an independent risk factor for cardiac events and mortality in NIDDM patients (2).

Cardiac complications of NIDDM can be explained by many mechanisms. It can be explained not only by the increase in left ventricle (LV) mass but by coronary artery stenosis, systolic heart failure and diastolic heart failure.

LVH is a well established effect of diabetes on the cardiac muscle. However, other cardiac pathologies secondary to diabetes have also been noted. Echocardiographic left atrial (LA) volume has been documented to be an independent predictor of cardiovascular events such as a greater risk of atrial fibrillation (3), incremental to a history of congestive heart failure, myocardial infarction, prediction of first ischemic stroke without AF(4) and mortality rate (5-7). Echocardiography can easily assess LA size and function

The objective of this study was to assess the prevalence of enlarged left atrial volume index (LAVI) in normotensive type 2 DM patients and to determine the correlation of LA volume in patients with and without LVH that have normotensive type 2 DM.

This study compared LA volume and LVH in diabetic type 2 patients without hypertension. Other parameters such as waist circumference, body mass index (BMI), blood
pressure, HbA1c, GFR, spot urine microalbumin/creatinine ratio, diabetic retinopathy were also reviewed.

The purpose of this study was to establish the use of LA volume as a prognostic indicator and as a new method of measurement in both research and treatment outcomes of cardiovascular disease in DM type 2 patients.

Methods

The study design was a cross-sectional analytic study. This study was approved by the Institutional Ethics Committee.

All patients in Rajavithi Hospital between April to December 2008 with a diagnosis of NIDDM and normotensive were consecutively considered for recruitment. Inclusion criteria were NIDDM, blood pressure < 130/80, no history of hypertension and not taking antihypertensive medication. Exclusion criteria were < 20 years old, pregnancy, structural heart disease (valvular heart disease, HCM, coronary artery disease, congestive heart failure, atrial fibrillation) chronic liver disease, chronic renal failure, and other systemic diseases such as hypothyroidism and hyperthyroidism.

The primary end-point was the correlation of LA volume in LVH and non-LVH patients with normotensive type 2 DM. The secondary end-points were the correlation between LA volume and several factors (current smoker, BMI, waist circumference, diabetic retinopathy, HbA1C, GFR, microalbuminuria).

LV and LA structure and function were quantified using two-dimensional echocardiography (8) and divided into two groups by LVH and measuring LA Volume in both groups. Current smoker, BMI, waist circumference, diabetic retinopathy, HbA1C, GFR, microalbuminuria were measured for secondary end-points. The LA volume was measured off line by using a biplane area length method in four and two chamber views. LV mass was by the Durreroux and Reichek method (8). Other systolic and diastolic functions were measured (EF, E/A, E/E’, Diastolic grading, LA Volume, LVM).

Table 1. Baseline characteristics between LVH and non-LVH patients.

<table>
<thead>
<tr>
<th></th>
<th>no LVH (n = 29)</th>
<th>LVH (n = 10)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50.86 ± 9.3</td>
<td>57.3 ± 4.9</td>
<td>0.07</td>
</tr>
<tr>
<td>Male</td>
<td>7 (24%)</td>
<td>0 (0%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Female</td>
<td>22 (76%)</td>
<td>10 (100%)</td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>1 (3%)</td>
<td>3 (30%)</td>
<td>0.01</td>
</tr>
<tr>
<td>BMI</td>
<td>26.5 ± 4.1</td>
<td>24.09 ± 4.2</td>
<td>0.05</td>
</tr>
<tr>
<td>Waist</td>
<td>86.69 ± 11.6</td>
<td>83.76 ± 8.2</td>
<td>0.23</td>
</tr>
<tr>
<td>SBP</td>
<td>118.4 ± 6.5</td>
<td>122.3 ± 6.8</td>
<td>0.78</td>
</tr>
<tr>
<td>DBP</td>
<td>70.65 ± 6.9</td>
<td>69.1 ± 6.4</td>
<td>0.25</td>
</tr>
<tr>
<td>DR</td>
<td>1 (3%)</td>
<td>9 (90%)</td>
<td>0.48</td>
</tr>
<tr>
<td>LVEF</td>
<td>65.8 ± 6.2</td>
<td>66 ± 9.3</td>
<td>0.47</td>
</tr>
<tr>
<td>HbA1C</td>
<td>7.86 ± 1.3</td>
<td>7.52 ± 1.1</td>
<td>0.23</td>
</tr>
<tr>
<td>GFR</td>
<td>110.98 ± 37.5</td>
<td>87.68 ± 17.9</td>
<td>0.05</td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td>1 ± 1.8</td>
<td>0.29 ± 0.43</td>
<td>0.04</td>
</tr>
<tr>
<td>Diastolic dysfunction</td>
<td>20/27 (74%)</td>
<td>10/10 (100%)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

BMI = body mass index, SBP = systolic blood pressure, DBP = diastolic blood pressure, DR = diabetic retinopathy, LVEF = left ventricular ejection fraction, HbA1C = hemoglobin A1C, GFR = glomerular filtration rate
Definitions

Abnormal LA volume was defined if LAVI (Left atrial volume index) was ≥ 30ml/m² (9).

LVH was defined if
LVMI was > 131 g/m² in male patients
LVMI was > 100 g/m² in female patients

Statistical analysis

Independent variables for the model were identified, and then the effect of each potential predictor was examined using univariate logistic regression.

Data were analyzed by parametric or nonparametric methods. According to their distribution comparisons were made using analysis by the students t test for continuous variable data and the chi-square test for categorical variable data.

The prevalence of LVH and enlarged LAVI are reported as percentage. Correlation between LVH and enlarged LA volume was calculated by the kappa value. All tests were 2-tailed, and analyses were performed using SPSS (Version 11.5).

Results

From this cross-sectional study 39 patients were included in the study. Baseline characteristics are shown in Table 1. Smokers, microalbuminuria and diastolic function were significantly different in the two groups (LVH vs no LVH). The prevalence of LVH was 25% (10/39). Of the patients with LVH 40% had an enlarged LAVI 40 % (4/10). Patients without LVH had an enlarged LAVI in 13% (4/29). The prevalence of enlarged LAVI was 20.5% (8/39). The results are shown in Figures 1 and 2.

The calculated statistic for measurement of the correlation between LVH and enlarged LAVI by Kappa value was 0.28 (Poor correlation).

In the model adjusted for age, sex and several factors (smoker, BMI, blood pressure, waist circumference, HbA1C, GFR, spot urine microalbumin/creatinine ratio, diabetic retinopathy, ejection fraction, diastolic function) that were associated with LAVI is shown in Table 2.

In the model adjusted for several factors in Table 2 and LAVI did not meet the 0.05 level of significance

Table 2. Relation between LAVI and several factors.

<table>
<thead>
<tr>
<th></th>
<th>Not Enlarge LAVI (n = 31)</th>
<th>Enlarge LAVI (n = 8)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>51.41 ± 9.2</td>
<td>56.75 ± 5.7</td>
<td>0.06</td>
</tr>
<tr>
<td>Male</td>
<td>6/31 (19%)</td>
<td>1/8 (12.5%)</td>
<td>0.65</td>
</tr>
<tr>
<td>Female</td>
<td>25/31 (81%)</td>
<td>7/8 (87.5%)</td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>3/31 (9.6%)</td>
<td>1/8 (12.5%)</td>
<td>0.81</td>
</tr>
<tr>
<td>BMI</td>
<td>25.48 ± 4.1</td>
<td>27.45 ± 4.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Waist</td>
<td>85.01 ± 9.4</td>
<td>89.55 ± 15</td>
<td>0.14</td>
</tr>
<tr>
<td>SBP</td>
<td>118.5 ± 6.3</td>
<td>122.8 ± 7.3</td>
<td>0.05</td>
</tr>
<tr>
<td>DBP</td>
<td>70.25 ± 6.8</td>
<td>70.25 ± 6.5</td>
<td>0.49</td>
</tr>
<tr>
<td>DR</td>
<td>0/31 (0%)</td>
<td>1/8 (12.5%)</td>
<td>0.07</td>
</tr>
<tr>
<td>LVEF</td>
<td>66.5 ± 6.9</td>
<td>63.2 ± 7.0</td>
<td>0.13</td>
</tr>
<tr>
<td>HbA1C</td>
<td>7.89 ± 1.3</td>
<td>7.35 ± 1.1</td>
<td>0.14</td>
</tr>
<tr>
<td>GFR</td>
<td>103.07 ± 35.6</td>
<td>112.5 ± 33.2</td>
<td>0.25</td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td>0.97 ± 1.7</td>
<td>0.3 ± 0.46</td>
<td>0.16</td>
</tr>
<tr>
<td>Diastolic dysfunction</td>
<td>23/31 (74%)</td>
<td>7/8 (87.5%)</td>
<td>0.36</td>
</tr>
</tbody>
</table>

BMI = body mass index, SBP = systolic blood pressure, DBP = diastolic blood pressure, DR = diabetic retinopathy, LVEF = left ventricular ejection fraction, HbA1C = hemoglobin A1C, GFR = glomerular filtration rate
Figure 1. Correlation between LVH and LAVI patients.

**Diabetes Type II in Rajavithi (39 pt.)**

- **LVH (10/39)**
  - LA volume: 4/39 (10.2 %)
  - Normal LA: 6/39 (15.4 %)

- **NON LVH (29/39)**
  - LA volume: 4/39 (10.2 %)
  - Normal LA: 25/39 (64.1 %)

**P = 0.07**

Figure 2. Correlation between LVH and LAVI patients.
chosen to account for multiple testing, however, systolic blood pressure between the two groups showed borderline significance (P = 0.05).

Discussion

This study showed a poor correlation between LVH and enlarged LAVI (kappa = 0.28) which is different from many previous studies. Simek CL et al (10) and Mureddu GF et al (11) found that LAVI parallels an increase in LVM but most studies included hypertension patients whereas in our study only normotensive NIDDM patients were included. This result can be explained that an enlarged LA Volume in DM type 2 patients is not necessarily only from LVH. Patients with enlarged LAVI had a higher systolic BP than patients with normal LAVI (borderline significance P = 0.05). Enlarged LAVI may be predictive of future hypertension. As a previous study by Paulista et al (12) compared individuals who had either persistently normal (<120 mmHg systolic and <80 mmHg diastolic) or prehypertensive blood pressure (120-139 mmHg or 80-89 mmHg) LA size was larger (36.5 versus 35.3 mm, P = 0.024) in the prehypertensive blood pressure group.

This study did not show significant correlations of enlarged LAVI and several other factors (current smoker, BMI, waist circumference, diabetic retinopathy, HbA1C, GFR, microalbuminuria).

The limitations of this study were the small sample size. Echocardiography is operator dependent making the measure less reproducible than CT or MRI. Follow up of patients with increased LAVI is needed to confirm the predictive value of LAVI for future hypertension.

Conclusion

The prevalence of enlarged LAVI was 20.5 % in type 2 DM with normotension. There was a poor correlation between LVH and enlarged LAVI in normotensive type 2 DM patients. The patients with enlarged LAVI probably have multiple causes. Enlarged LAVI may be predictive of future hypertension.

Conflict of Interest

None

References

8. Lang RM, Bierig M, Devereux RB, et al. Recommendations for chamber quantification: a report from the American Society of Echocardiography’s Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. J Am Soc Echocardiogr 2005; 18: 1440-63.
โครงการศึกษาปริมาตรของหัวใจห้องบนซ้ายที่เพิ่มขึ้น ในผู้ป่วยเบาหวานชนิดที่ 2 ที่มีความดันโลหิตปกติปรับเปียกในกลุ่มที่มีการเพิ่มปริมาณมวลกล้ามเนื้อหัวใจและกลุ่มที่ไม่มีการเพิ่มปริมาณมวลกล้ามเนื้อหัวใจ

นิทรรศการวิทยาศาสตร์, มหาวิทยาลัยศรีนครินทรวิโรฒ, บริเวศกร เพ็ญแก้ว

บทคัดย่อ

วัตถุประสงค์: ปริมาณของหัวใจห้องบนซ้ายที่เพิ่มขึ้นและการเพิ่มขึ้นของมวลกล้ามเนื้อหัวใจในกลุ่มผู้ป่วยที่เป็นเบาหวานชนิดที่ 2 มีความสัมพันธ์กับโอกาสการเกิดโรคหัวใจและหลอดเลือดที่เพิ่มขึ้นในอนาคต ซึ่งปัจจุบันปริมาตรของหัวใจห้องบนซ้ายเป็นตัวชี้วัดที่ดีกว่าการเพิ่มขึ้นของมวลกล้ามเนื้อหัวใจ การศึกษาการเพิ่มขึ้นในกลุ่มที่มีการเพิ่มปริมาณมวลกล้ามเนื้อหัวใจ พบว่าการเพิ่มขึ้นของมวลกล้ามเนื้อหัวใจอย่างเดียวไม่เท่าที่จะเปรียบเทียบกับการเพิ่มปริมาตรของหัวใจห้องบนซ้าย

วิธีการศึกษา: มีผู้ป่วยที่เข้าร่วมการศึกษานี้รวม 39 คน โดยผู้ป่วยทั้งหมดเป็นผู้ป่วยเบาหวานชนิดที่ 2 มีความดันโลหิตปกติ โดยมีการวัดปริมาตรหัวใจห้องบนซ้ายโดยใช้เครื่องEchoangiography และวัดค่า Left Atrial Volume index, Left ventricular mass index, Ejection Fraction, Diastolic Function หลังจากนั้นจึงวัดปริมาณมวลกล้ามเนื้อหัวใจระหว่างปริมาตรของหัวใจห้องบนซ้ายและปริมาณมวลกล้ามเนื้อหัวใจ

ผลการศึกษา: พบว่าความชุกของผู้ป่วยที่มีการเพิ่มขึ้นของปริมาณมวลกล้ามเนื้อหัวใจ 10 คน จาก 39 คนคิดเป็นร้อยละ 25 โดยส่วนมากเป็นผู้ป่วยที่มีการเพิ่มขึ้นของมวลกล้ามเนื้อหัวใจมีปริมาณมวลกล้ามเนื้อหัวใจ 4 คน จาก 10 คนคิดเป็นร้อยละ 40 และผู้ป่วยที่ไม่มีการเพิ่มขึ้นของปริมาณมวลกล้ามเนื้อหัวใจมีปริมาณมวลกล้ามเนื้อหัวใจ 13 คน จาก 29 คนคิดเป็นร้อยละ 43 โดยคำนวณทางสถิติหาความสัมพันธ์ระหว่างปริมาตรของหัวใจห้องบนซ้ายและปริมาณมวลกล้ามเนื้อหัวใจโดยใช้ค่า Kappa ซึ่งเท่ากับ 0.28 เปรียบเทียบความสัมพันธ์ใกล้เคียงในทางสถิติ ไม่ปรากฏ