Left Ventricular Diastolic Dysfunction in Obese Women

Idrus Alwi*, S Harun*, Satrio Sukmoko**, Pradana Suwondo***, Maryantoro Oemardi***, Sarwono Waspadji***, Sidartawan Soegondo***

ABSTRACT

Aim: to determine the direct effect of obesity on echocardiographic indices of diastolic left ventricular function

Methods: 44 obese (BMI ≥ 25 kg/m²) and 45 normal weight women were studied. They had no other pathological conditions. Echocardiographic indices of diastolic function were obtained, and dysfunction was assumed when at least two values differed by ≥ 2 SD from the normal weight group.

Results: in obese subjects, the values of maximum velocity of active mitral filling (A) were increased and pulmonary diastolic velocity was decreased significantly (p<0.01); all other diastolic variables were unchanged. Subclinical diastolic dysfunction tend to be more prevalent among obese subjects but it was not significantly different from non obese (p= 0.11), being present in nine obese (20.5%) and 4 normal (8.9%) subjects.

Conclusion: subclinical left ventricular diastolic dysfunction is present in obese women.

Key words: diastolic dysfunction, obesity.

INTRODUCTION

It is already known that obesity influences cardiovascular morbidity and mortality.1-5 Obesity has been associated with heart failure,6,7 and individuals with severe obesity have long been recognized to have a form of cardiomyopathy attributed to chronic volume overload, characterized by left ventricular (LV) dilation, increased left ventricular wall stress, and compensatory (eccentric) left ventricular hypertrophy.

Impairment of cardiac function has been reported to correlate with BMI and duration of obesity,9,10 with most studies reporting abnormal diastolic function.11 These early manifestations may be important, because treatment to reverse the process is most likely to be effective earlier in the disease.

Studies using echocardiography have shown correlation between morbid obesity and diastolic dysfunction.12 These associations appear to be present even in cases of slight or mild obesity.13 However, the relation between obesity and alterations in diastolic function in Indonesia has not been reported.

Our aim in this study was to determine the effect of obesity on echocardiographic indices of diastolic left ventricular function in obese women.

METHODS

We studied 44 obese women (mean (SD) age, 36.7 (6.9) years) and 45 non-obese control women (mean age, 36.4 (6.3) years). Obesity was defined as a body mass index (BMI) of ≥ 25 kg/m², with clear evidence from a physical examination of excessive subcutaneous adipose tissue. The participants in the study were classified into two groups based on the BMI: a normal weight (control) group had a BMI of < 25 kg/m²; obese was classified as a BMI > 25 kg/m².

In order to exclude conditions that might influence the results, the following criteria were required: simple obesity; female, of child bearing potential; not suffering from hypertension, or diabetes mellitus; no previous history or clinical evidence of coronary artery disease, heart failure, or cardiac valve disease; normal ECG; no respiratory disease; not suffering from any chronic or acute disease; and not taking any drugs that could affect the heart. Echocardiographic images had to be of sufficient quality to allow reproducible cross sectional, M mode, and Doppler studies.

All subjects provided a fully informed written consent for their participation in the study, and the protocol was approved by the ethics committee of our hospital.

All participants provided information on age, family history, coronary artery disease risk factors, personal habits (type and level of physical exercise, drug ingestion, known pathological conditions) and the
duration of the obesity. Detailed physical examination was conducted to exclude endocrine and cardiac comorbidities. Height and weight were measured and the BMI was calculated as the weight (kg)/height$^2$ (m$^2$). A 12 lead ECG was obtained. Haematological and biochemical variables were determined from fasting blood samples and included glucose, total cholesterol, triglycerides, high density lipoprotein cholesterol and low density cholesterol.

A cross-sectional echocardiogram (Philips) was obtained from all participants. Echocardiograms were undertaken in our echocardiograph laboratory following standard methods. They included cross sectional, M mode, and Doppler studies. Measurements of all variables were made off-line by one observer who was without knowledge of the patients’ clinical details.

The following indices of the left ventricular diastolic function were evaluated. $^{14-16}$ Pulsed Doppler measurements were obtained in the apical four chamber view: the Doppler beam was aligned as perpendicularly as possible to the plane of the mitral annulus and a 5 mm pulsed wave Doppler sample volume was placed between the tips of the mitral leaflets during diastole. The following variables were calculated: maximum velocity of passive mitral filling (E); maximum velocity of active mitral filling (A); ratio of passive to active velocity (E/A); deceleration slope, and isovolumic relaxation time (IVRT). Pulmonary venous flow recordings were obtained from the four-chamber view directed at the right upper pulmonary vein. Sample volume was obtained 1–2 cm into the pulmonary vein, and the following measurements were carried out: peak S wave velocity in centimeters per second (peak systolic pulmonary venous inflow velocity during early phase of atrial diastole), and peak A wave velocity in centimeters per second (peak reversed systolic wave during atrial contraction).$^{16}$

A difference of more than 2 SD from the mean values of the normal weight group was used to estimate the prevalence of cardiac functional abnormalities.

Statistical Analysis

Descriptive statistics were done on each of the variables to obtain the frequency distributions. Quantitative variables were described as mean (SD). Comparisons between the obese group and the normal weight group were analysed by t-tests. Probability values of $p < 0.05$ were considered significant.

RESULTS

Characteristics of The Groups in The Study

The characteristics of the patients studied are presented in table 1.

Left Ventricular Diastolic Function

The measured indices of the left ventricular diastolic function are presented in table 2. In obese subjects, the values of A were increased and pulmonary diastolic velocity was decreased significantly. There were no differences between the values of E, deceleration time (DT), IVRT, MV a duration, PV systolic, PV a duration and PV velocity in obese and normal weight subjects.

In the prevalence assessment (Figure 1), subclinical diastolic dysfunction was more prevalent among obese patients than in the control group. Overall, 9 obese women (20.5% of all the obese women) and 4 non obese women (8.9% of all the non obese women) had diastolic dysfunction, but it was not significant ($p = 0.11$).
cated obesity could be caused by the combined effect of hemodynamic and metabolic factors.9

The A was found to be significantly higher in the obese women. This parallels the findings in other studies and suggests an abnormal relaxation of the left ventricle, with increased dependency on left atrial contraction for normal filling. The E, deceleration time and IVRT was similar in the obese subjects and the normal subjects. The associations of these indices with obesity reported in previous studies have been variable. Chakko et al.,21 did not find significant differences in the values of E, but values of A were increased, resulting in a decreased E/A ratio. Conversely, Zarich et al.22 observed a significant decrease in the maximum velocity of passive mitral filling (E) among obese patients, while the values for active mitral filling (A) were not significantly affected, resulting in a decrease in the E/A ratio. Stoddard et al.,23 found a significant increase in both E and A values, which were positively correlated with the percentage of body weight in excess of the ideal, so that the E/A ratio was not altered.

The Doppler method of measuring indices of the left ventricular filling has been shown to be of great value in assessing diastolic function. However, when volume overload is present, as it is in obesity, normal values may result, as the increase in left atrial pressure caused by intravascular volume can mask the alterations observed in the early phases of abnormal diastolic relaxation. Pascual M et al.9 found that alterations in diastolic function were common. These alteration in diastolic function correlated strongly with body mass index. In obesity, cardiac adaptation to chronic volume overload is associated with eccentric hypertrophy and abnormalities of diastolic function from the initial stages, indicating that structural changes and an obesity cardiomyopathy are present in all obese individuals.21

As a consequence, greater awareness needs to be focused on weight loss in order to induce beneficial changes in cardiac morphology and function. The alterations that occur in obesity can be reversed easily and quickly by weight loss, to the long term benefit of the patient.24-27

**Limitations**

The selection of the study sample, which included only women, precludes extrapolation of our results to the general population.

**CONCLUSION**

Among patients with obesity, subclinical left ventricular diastolic dysfunction is present in obese women.

**Table 2. Indices of Left Ventricular Diastolic Function**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obesity (mean, SD)</th>
<th>Normal (mean, SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>90.89 (14.74)</td>
<td>89.59 (16.16)</td>
<td>0.69</td>
</tr>
<tr>
<td>A</td>
<td>73.63 (15.16)</td>
<td>67.13 (12.64)</td>
<td>0.03</td>
</tr>
<tr>
<td>Deceleration time</td>
<td>207.5 (43.41)</td>
<td>206.44 (29.26)</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Values are mean (SD).
P, for differences between obese subgroups and normal weight group. A, maximum velocity of active mitral filling; E, maximum velocity of passive mitral filling; IVRT, isovolumic relaxation time; MV, mitral valve; PV, pulmonary valve.
REFERENCES