CORRELATION OF BODY MASS INDEX WITH TISSUE DOPPLER PARAMETERS IN OBESE MIDDLE AGE SUBJECTS

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ABSTRACT

Overweight/obesity is common conditions encountered in daily medical practice, and it is expected that obesity is an important cause of heart failure. Tissue Doppler imaging (TDI) is a useful non-invasive tool providing accurate diagnostic and prognostic values in diastolic dysfunction; furthermore, TDI is relatively load-independent and this issue is of utmost importance in the setting of heart failure when loading parameters are usually disturbed. The aim of this study was to evaluate the correlation between the body mass index as an indicator of the degree of obesity and different tissue Doppler parameters in order to early diagnosis of obesity induced changes on the heart and treat them earlier. Eighty (80) middle age subjects of either sex involved in this study. They were divided into two groups according to their body mass index (BMI): Group 1: with normal body mass index (18.5-24.9 kg/m²), (no.38) and Group 2: obese (BMI ≥30 kg/m²), (no.42). This study was performed during the period from November 2015 until April 2016, at the echo unit of Ibn Al-Bitar hospital for cardiac surgery. The tissue Doppler echocardiography was performed for each subject using Phillips (IE33 model) system (USA) echocardiographic device, with a transducer operating at 3.5 MHz. A significant difference was found regarding body weight, waist circumference, and BMI between the two groups of subjects involved in the study, but there was no significant difference found regarding age and body height. The Tissue Doppler image parameters of echocardiography showed a statistically significant differences concerning Em, Am, Em/Am ratio and E/Em ratio. A positive linear correlation was found between E/Em ratio and both BMI and WC. By this study we find a correlation of body mass index with tissue Doppler parameters in obese middle age subjects.

Keywords: Obesity, tissue Doppler, body mass index, waist circumference

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INTRODUCTION

Overweight/obesity are common conditions encountered in daily medical practice, and it is expected that obesity will become an important cause of heart failure in the coming years¹. Obesity has been linked to a spectrum of more minor cardiovascular changes, ranging from hyperdynamic circulation to sub-clinical cardiac structural changes. These early manifestations may be important because treatment to reverse this
process is most likely to be effective earlier in the disease\(^2\). Non-invasive cardiac modalities, including echocardiography and related techniques and magnetic resonance imaging have permitted evaluation of cardiac morphology in overweight patients and subjects with all classes of obesity, including those with and without HF. These techniques have also facilitated comparisons with lean patients and assessment of LV geometry in obese subjects\(^3\). Studies employing tissue Doppler imaging have demonstrated decrease systolic and diastolic velocities of the lateral tricuspid annulus. The prevalence of such abnormalities with various degrees of severity of obesity is unknown \(^4\). Tissue Doppler imaging (TDI) is a useful non-invasive tool providing accurate diagnostic and prognostic values in diastolic dysfunction; furthermore, TDI is relatively load-independent, and this issue is of utmost importance in the setting of heart failure when loading parameters are usually disturbed\(^5\).

The aim of this study was to evaluate the correlation between the body mass index as an indicator of the degree of obesity and different tissue Doppler parameters in order to early diagnosis of obesity induced changes on the heart and treat them earlier.

**MATERIALS AND METHODS**

Eighty (80) middle age subjects of either sex involved in this study. They were divided into two groups according to their body mass index (BMI):

Group 1: with normal body mass index (18.5-24.9kg/m\(^2\)).(no.38)

Group2: obese (BMI \(\geq\)30 kg/m\(^2\)).(no.42)

This study was performed during the period from November 2015 until April 2016, at the echo unit of Ibn Al-Bitar hospital for cardiac surgery. The subjects involved in this study were: selected randomly as friends, relatives and medical staff in the hospital, each subject was adequately informed about the aim of the study and signed an informed consent. The experiments were performed in accordance with the Helsinki Declaration of 1975.

**Exclusion criteria:** Smoking, History of ischemic heart disease.

- History of hypertension (systolic blood pressure \(\geq\)140 mm Hg or diastolic blood pressure \(\geq\)90 mm Hg at the time of the visit (mean of 2readings), or use of antihypertensive medications.
- History of diabetes or use of diabetes medications.
- Patient’s self-report of hypercholesterolemia or use of lipid lowering treatment, Congenital or rheumatic heart disease (Valvular heart disease like Mitral stenosis or regurgitation, or Aortic stenosis or regurgitation).
- Cardiac Arrhythmia like atrial fibrillation, Patients with poor window study.

Before performing the echocardiographic examination, a careful medical history was taken from each patient. Clinical and physical examination were done also. BMI was calculated as: weight (kg)/height-squared (m\(^2\)).
Weight was measured using weight measuring device, and height using a measuring tape. According to a standard definition, normal body mass index (18.5-24.9 kg/m²), and obesity as BMI ≥30 kg/m².

Waist circumference (WC) was measured using measuring tape at the level of the umbilicus.

**Tissue Doppler Image:**

Records the motion of tissue or other structures with a velocity or frequency shift much lower than that of blood flow, the tissue Doppler echocardiography was performed for each subject using Phillips (IE33 model) system (USA) echocardiographic device, with a transducer operating at S3.5 MHz, the echo examination takes about 15-20 minute.

Using pulsed wave Doppler Peak E-wave velocity (mm/sec) was measured, as the highest velocity of left ventricular early rapid filling.

The following Tissue-Doppler image echocardiographic parameters were calculated:
1. Pulsed TDI sample volume was placed at the level of the lateral and septal mitral valve annulus, and the peak early diastolic velocities (Em) were measured and then averaged.
2. Peak late diastolic mitral annular velocity (Am)(cm/s).
3. The ratio between peak E-wave velocity and peak early Em wave velocity (E/Em).(6)

**Statistical Analysis:**

All calculations and analyses were performed using Statistical Package for the Social Sciences, (SPSS version 17 for windows, SPSS Inc., Chicago, Illinois) computerized Program and excel Microsoft office program. Echocardiographic data were presented as mean ± standard deviation (SD) for continuous variables. The level of statistical significance was defined as P value <0.05, which was obtained by comparing the calculated t-value to the tabulated t-value at 95% confidence interval.

**RESULTS**

The demographic data of subjects involved in this study was shown in table(1): A significant difference was found regarding body weight, waist circumference, and BMI between the two groups of subjects, but there was no significant difference found regarding age and body height, (P value= 0.072,0.918) respectively.

**Table1: The Demographic characteristics of subject groups**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1 (normal weight) n=38</th>
<th>Group 2 (obese) n=42</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(year)</td>
<td>36.6 ± 7.4</td>
<td>42.5 ± 6.5</td>
<td>0.072</td>
</tr>
<tr>
<td>B.wt(kg)</td>
<td>66.8 ± 8.8</td>
<td>104.8 ± 15.7</td>
<td>0.0001*</td>
</tr>
<tr>
<td>B.height(cm)</td>
<td>172.5 ± 9.1</td>
<td>173.2 ± 8.5</td>
<td>0.918</td>
</tr>
</tbody>
</table>

Values were expressed as mean ± SD.*Significant P-value less than 0.05.

B. wt: Body Weight, B. height: Body height, WC: Waist Circumference, BMI: Body mass index

### Tissue Doppler image parameters:

The Tissue Doppler image parameters of echocardiography of subject groups was shown in Table 2, there were a statistically significant differences concerning **Em (early diastolic mitral annular velocity)** when comparing Group1 with Group2 (P= 0.0001).

Regarding **Am (Late diastolic mitral annular velocity)** there was a significant difference between Group1 with Group 2 (P=0.002). Concerning **Em/Am ratio** there were a statistically significant differences in comparing the two groups, while in comparing E/Em there was a significant difference between Group1 with Group2(P= 0.008).

**Table 2: Tissue Doppler image parameters among subject groups**

<table>
<thead>
<tr>
<th>Tissue Doppler parameters</th>
<th>Group1 (n=38)</th>
<th>Group2 (n=42)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Em wave (mm/s)</td>
<td>82.1±14.6</td>
<td>79.4±13.3</td>
<td>0.0001*</td>
</tr>
<tr>
<td>Am wave (mm/s)</td>
<td>63.4±15.8</td>
<td>79 ± 16.4</td>
<td>0.002*</td>
</tr>
<tr>
<td>Em/Am ratio</td>
<td>1.6 ± 0.9</td>
<td>1.03 ± 0.8</td>
<td>0.0001*</td>
</tr>
<tr>
<td>E/Em ratio</td>
<td>5.04 ± 1.5</td>
<td>6.3±1.6</td>
<td>0.008*</td>
</tr>
</tbody>
</table>

Values were expressed as mean±SD.

- *Significant P-value less than 0.05.
- Group1=normal weight, Group2= obese.
- Em=Early diastolic mitral annular velocity, Am=Late diastolic mitral annular velocity, E=Early transmitral velocity.

The correlation between BMI (Body mass index) and (E/Em ratio) was shown in figure (1).There was a positive linear correlation (R² = 0.2514, P = 0.0001).
Figure 1: Correlation between BMI (Body mass index) and (E/Em ratio)

There was a positive linear correlation between the WC (waist circumference) and (E/Em ratio), \( R^2 = 0.1429, p = 0.0006 \) as shown in figure 2.

Figure 2: Correlation between waist circumference and E/Em ratio

DISCUSSION

The prevalence of obesity is steadily increasing worldwide and constitutes a major health issue because of its association with morbidity, mortality, and cardiovascular diseases. An increase in body size,
besides being associated with cardiovascular risk factors such as hypertension, diabetes mellitus, and hyperlipidemia, directly affects cardiac structure and function. We divided our groups according to their BMI in which: Group 1 with normal body mass index (18.5-24.9 kg/m²), Group 2 obese (BMI ≥30 kg/m²), this grouping of the study subjects was similar to what was done by in their study Obesity and Preclinical Changes of Cardiac Geometry and Function.

Regarding abdominal obesity, a waist circumference of > 102 cm in men or > 88 cm in women indicates that the risk of metabolic and cardiovascular complications of obesity is high as found in their study. Also another study done by, who studied women with waist circumference of ≥ 80 cm and higher BMI than 30 found them to have higher risk of developing subclinical cardiac dysfunction. Our result in figure (2) was in harmony with what was found by, as they said waist circumference (WC) was significantly associated with LV diastolic dysfunction—independently of BMI—in women they studied, and that, the adverse effect of central adiposity on left ventricular (LV) diastolic function was independent of general adiposity and more pronounced among women. The prevalence of obesity is increasing in the developed and developing world. It is an independent risk factor for heart failure. Left ventricular (LV) diastolic dysfunction has been demonstrated to be a strong predictor of heart failure.

Tissue Doppler imaging (TDI) is a useful non-invasive tool providing accurate diagnostic and prognostic values in diastolic dysfunction; furthermore, TDI is relatively load-independent. The result of this study reflects the association of TDI parameters with obesity (table 2, figures 1 & 2) in the development of diastolic dysfunction, this finding was in consistent with what had been reported by, who concluded that BMI is an independent predictor of LV diastolic dysfunction and they found a higher E/Em and lower Em in obese subjects as we found. Also our finding of (low Em/Am, high E/Em), goes with what had been found by. Our result in (figure1 & 2) proved a significant positive correlation between BMI, WC, & E/Em ratio which goes with who concluded that Insulin resistance and BMI correlated significantly with indices of LV function in obese children. Importantly, higher BMI also related significantly to standard measurements of diastolic dysfunction such as LAV enlargement, higher E/Em, and lower Em values as indicators of impaired LV filling. Greater BMI during young adulthood and middle age is associated with reduced LV systolic and diastolic function assessed by myocardial deformation in the CARDIA study comprising a large biracial cohort of adults 43 to 55 years of age.

CONCLUSION

By this study we find a correlation of body mass index with tissue Doppler parameters in obese middle age subjects.

ACKNOWLEDGMENT

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ETHICAL CLEARANCE

The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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REFERENCES


(19) Satoru Kishi., et al. Association of Obesity in Early Adulthood and Middle Age With Incipient Left Ventricular Dysfunction and Structural Remodeling: The CARDIA Study (Coronary Artery Risk Development in Young Adults), JACC: Heart Failure, 2014; Volume 2, Issue 5, Pages 509-511.