Characterization of Heart wall Diseases in Patients with Type-2 Diabetes Mellitus using Echocardiography

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Abstract: This study aimed to characterize and compare the heart wall disease in type-2 diabetic patient using echocardiography ultrasound scan in order to assess these changes among both gender. Study population comprises a total of 113 adult’s diabetic patients 46 male 41.59% with mean age of 57.98 ±11.107 and 66 female 58.41%, with mean age of 56.03 ±10.270. Underwent ultrasound examination after known diagnosis with diabetic disease using two-dimensional Real Time US machine with curvilinear transducer of (3.5–6 MHz) at Ribat hospital, ventricular and atrial wall measurement was performed. Aortic trans aortic flow was assessed by identifying the projection in which maximum peak flow velocity noted, after calibration, tracing the black-white interface outlining the Doppler flow envelope. Heart rate was measured simultaneously. The result showed that Means of Echocardiography parameters for Diabetes Type-2 patients between male and female was compared as the BMI having mean ± SD (23.09967Kg/m² ±2.898752), (27.01367Kg/m² ±6.179767) the p-value 0.000101, Aortic root diameter (31.09 mm±3.425), (28.15 mm±3.553) the p-value 0.000026, left atrial diameter (36.87 mm±5.195), (44.47 mm±5.342) the p-value 0.02, And Left Ventricle systolic diameter (30.64mm ±5.306), (28.64 mm± 5.110) the p-value 0.045766. For male and female respectively. Non–insulin-dependent DM has independent adverse cardiac effects, including increased LV mass and wall thicknesses, reduced LV systolic chamber and myocardial function, and increased arterial stiffness.

Keywords: Characterization, Echocardiography, Heart, Diabetic Patient

1. Introduction

The number of people with diabetes in Africa is projected to increase substantially in the next two decades, due to factors including rapid urbanization, adoption of unhealthy diets and exercise patterns and the ageing of the population.

Diabetes is a group of diseases characterized by elevated blood glucose concentration. It may be a result of either the body does not produce enough insulin or because cells do not respond to the insulin that is produced it can be classified into three major classes: Type-1, Type-2 and Gestational diabetes mellitus (Jameson, 2006). (Type-1 diabetes known as insulin-dependent diabetes (IDDM) (Devereux et al., 1997), childhood diabetes or also known as juvenile diabetes, is characterized by loss of the insulin producing beta cells of the islets of Langerhans of the pancreas leading to a severe deficiency of insulin (Gardner and Greenspun, 2007). (Type-2 diabetes mellitus known as adult-onset diabetes or non-insulin dependent diabetes mellitus (NIDDM) is characterized by insulin resistance which may be combined with relatively reduced insulin secretion.

The defective responsiveness of body tissues to insulin is believed to involve the insulin receptor (Benedict C., 2004). Gestational diabetes mellitus resembles type-2 diabetes in several aspects, involving a combination of inadequate insulin secretion and responsiveness. It occurs in about 2% to 5% of all pregnancies and may improve or disappear after delivery (Lawrence et al., 2008). When the glucose increases in the blood it can cause serious complications including: Cardiomyopathy, nephropathy, neuropathy, and retinopathy (Cheung et al., 2007).

Diabetes is a major risk factor for coronary artery disease and cardiovascular disease (Somaratne et al., 2011) is the most important cause of morbidity and mortality in patients with type-2 diabetes, accounting for approximately two-thirds of total mortality (Srivastava et al., 2008).

Diastolic dysfunction has been described as an early sign of diabetic heart muscle disease preceding systolic damage (Raev, 1994) it is associated with future occurrence of heart failure, is a predictor of cardiovascular morbidity and mortality in the general population (Ike and Ikeh, 2006). The late effect of diabetes cardiomyopathy is characterized by LV hypertrophy and myocardial dilatation, which leads to LV diastolic and systolic dysfunction (Galdersi, 1991). The aim of this study is to assess the cardiac performance for patients with diabetes mellitus in order to characterize the effect of the diabetes to the heart between two groups (of gender) which will be more due to sex.
2. Material and Methods

This study was aimed to characterize the heart disease in diabetic patient using Echocardiography. The room recruiting patients from wards and outpatient clinics of ElRibat Teaching hospital in Khartoum. Study population comprises a total of 113 adult’s diabetic patients 46 male 41.59% with mean age of 57.98 Std. devastation 11.107 and 66 female 58.41%, with mean age of 56.03 Std. devastation 10.270. patient with diagnosed status of diabetes were underwent ultrasound scan in order to evaluate their heart and to detect the changes that may induced by this type of disease, Pregnant females, normal study population and patient without unknown diabetic status were excluded from this study.

Height was taken in meters (m), and weight was measured to calculate the BMI for all patient. All the US examinations and measurements were performed using two-dimensional Real Time US machine with curvilinear transducer of (3.5–6 MHz).

LV internal dimension and interventricular septal and posterior wall thicknesses were measured at end diastole and end systole according to American Society of Echocardiography (ASE) recommendations. (Sahn et al., 1978) When optimal orientation of the M-mode line could not be obtained, correctly oriented leading-edge linear dimension measurements were made from 2-dimensional images. Aortic annular diameter was measured as previously described Devereux, 1997, Doppler trans aortic flow was assessed by identifying the projection in which peak flow velocity was maximal and, after calibration, tracing the black-white interface outlining the Doppler flow envelope. Heart rate was measured simultaneously.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Male DM Mean ± SD</th>
<th>Female DM Mean ± SD</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>23.1 ± 2.9</td>
<td>27±6.18</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>ARD</td>
<td>31.1±3.4</td>
<td>28.15±3.6</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>LAD</td>
<td>36.9±4.2</td>
<td>34.47±3.7</td>
<td>&lt; 0.002</td>
</tr>
<tr>
<td>LVId</td>
<td>46.9±5.2</td>
<td>44.47±5.5</td>
<td>&lt; 0.022</td>
</tr>
<tr>
<td>LVId</td>
<td>30.6±5.3</td>
<td>28.64±5.1</td>
<td>&lt; 0.047</td>
</tr>
<tr>
<td>IVSD</td>
<td>12.1±1.9</td>
<td>12.05±2.1</td>
<td>&lt; 0.830</td>
</tr>
<tr>
<td>LVPWD</td>
<td>10.5±1.35</td>
<td>10.30±1.45</td>
<td>&lt; 0.441</td>
</tr>
</tbody>
</table>

BMI: Body Mass Index,
ARD: Aortic Root Diameter,
LAD: Left Atrial Diameter,
LVId: Left Ventricular Diastolic Diameter,
LVId: Left Ventricular Systolic Diameter,
IVSD: Inter Ventricular Septum Diameter,
LVPWD: Left Ventricle Posterior Wall Diameter
EF: Ejection Fractional

Figure 1: Showed Parasternal Long axis views

3. Result Presentation

Table 1: Cross tabulation of gender Vs diabetic status

<table>
<thead>
<tr>
<th>Gender</th>
<th>Diabetes mellitus status</th>
<th>Non- Diabetes</th>
<th>Diabetes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Count</td>
<td>71</td>
<td>47</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>Total %</td>
<td>29.20%</td>
<td>19.30%</td>
<td>48.60%</td>
</tr>
<tr>
<td>Female</td>
<td>Count</td>
<td>59</td>
<td>66</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>Total %</td>
<td>24.30%</td>
<td>27.20%</td>
<td>51.40%</td>
</tr>
</tbody>
</table>

Figure 2: Compare mean of BMI between Diabetes patients in gender.

Figure 3: Error bar means of ARD for both gender
4. Discussion

Cardiovascular disease remains the leading cause of death in the world as well as in the Sudan territories. Approximately 80% of all cardiovascular-related deaths occur in low- and middle-income countries and at a younger age in comparison to high-income countries Gersh et al. (2010). Two-dimensional echocardiography has recently gained popularity as a noninvasive diagnostic aid in the evaluation of various forms of heart disease. Although M-mode echocardiography is valuable in detecting wall motion changes related to ischemia. Corya et al. (1975), We examined 113 subject was diabetes male 47 and 66 female in present study, the body mass index was found to be very highly significant with p value 0.001 in diabetes more than non-diabetes, This finding was in counterbid with Mansour (2014) study that found the high population attributable risks were related to excess weight (BMI ≥25) for the outcomes hypertension (26% men; 28% women), angina pectoris (26% men; 22% women), and CAD (23% men; 15% women).

The study revealed the age range (30-85 years) having mean of 55.76 years and standard Deviation 13.632. The high number of diabetes was female patients in age group 50-60, according to Werfalli et al (2013) who reported the majority of individuals with diabetes in Africa under 60 years old with the highest proportion (43.2%) in people aged 40–59 years. Current study showed that the BMI was higher in female than male (p-value 0.0001) which is considered as significant difference. The gender and BMI as significant factors in DM patients was explained by Richard B. (Devereux et al (2000) who reported that the BMI was higher in diabetic women than men.

Means of Echocardiography parameters for Diabetes Type-2 patients between male and female was compared as firstly the BMI having mean ±StD (23.09967 Kg/m² ±2.898752) and (27.01367 Kg/m² ±6.179767) the p-value .000101, Aortic root diameter (31.09 mm±3.425) and (28.15 mm±3.553) the p-value 0.000026, left atrial diameter (36.87 mm±4.241) and (34.47 mm 3.726) the p-value 0.001856, Left ventricular diastolic diameter (46.87 mm±.5.195) and (4.47 mm±5.542) the p-value 0.02. And Left Ventricle systolic diameter (30.64 mm ±5.306) and (28.64 mm± 5.110 the p-value 0.045766 for male and female respectively.

On the other hand the other echo finding parameters are higher in male than female such as left ventricular diastolic diameter, Aortic root diameter, left atrial diameter and left ventricle systolic diameter that findings demonstrate that pre-clinical diastolic dysfunction is common in patients with DM. as in figure 2, 3, 4, and 5.

Preclinical diastolic dysfunction has been broadly defined as diastolic dysfunction in patients with normal systolic function, and no symptoms of heart failure (HF). As stated by Patil et.al (2011) and Patil et al. (2011) they reported that the study reveals high burden of diastolic dysfunction in cohort of type 2 DM population, Adeoye et.al 2012, who reported that the older patients is more vulnerable to type 2 diabetes.

5. Conclusions

Non–insulin-dependent DM has independent adverse cardiac effects, including increased LV mass and wall thicknesses, reduced LV systolic chamber and myocardial function, and increased arterial stiffness. These findings identify adverse cardiovascular effects of DM, independent of associated increases in BMI and arterial pressure that may contribute to cardiovascular events in diabetic individuals.

References


Author Profile

Dr. Asma Ibrahim Ahmed (Sudan), awarded the B.Sc. in diagnostic radiology technology (1996), M.Sc. in medical ultrasound (2005, SUST), as well as PhD degree in diagnostic radiology (SUST, 2012), during 1998 she has been working as teaching assistant at COMRS, SUST, as well as lecturer, and assistant professor in 2005, and 2012 respectively. She has been active in diagnostic radiology, medical ultrasound researches.

Mohammed A. Elhaj received the B.Sc. and M.S. degrees in Medical Radiology Science and medical Diagnostic ultrasonography in Sudan University of science and Technology in 2001 and 2007, respectively. During 2001-2007, he has been working as medical radiology specialist, 2007 had become a lecture in international academic for health science. Now he is PhD student at SUST.

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