International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

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

Asma I. Ahmed[1], Mohamed A. Elhaj[1], Elsafi A. Abdullah[1], Mohamed Omer[1], Moawia G. Elddin[1], A. Hassan A. B[1, 2, 3, 4]

[1]Sudan University of Science and Technology, College of Medical Radiological Science, Khartoum, Sudan

[2]Radiology Department, Elnileen Diagnostic Medical Center, Khartoum, Sudan

[3]Radiology Department, Antalya Medical Center, Khartoum, Sudan

[4]National university-Sudan, Faculty of Radiography & Medical Imaging, Khartoum, Sudan

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 annular diameter, Doppler 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/m^2 ±2.898752), (27.01367Kg/m^2 ±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 (36.87mm±4.241, (34.47mm±3.726) the p-value 0.001856, Left ventricular diastolic diameter (46.87 mm±5.195), (44.47 mm±5.542) 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 Greenspan, 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 (Galderisi, 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.

Figure 1: Showed Parasternal Long axis views

3. Result Presentation

Table 1: Cross tabulation of gender Vs diabetic status

Gender		Diabetes mellitus status		
		Non- Diabetes	Diabetes	Total
Male	Count	71	47	118
	Total %	29.20%	19.30%	48.60%
Female	Count	59	66	125
	Total %	24.30%	27.20%	51.40%

Table 2: Showed echo-parameters for both gender having type-2

Variable	Male DM Mean ± SD	Female DM Mean ± SD	p value
BMI	23.1 ± 2.9	27±6.18	< 0.001*
ARD	31.1±3.4	28.15±3.6	< 0.001*
LAD	36.9±4.2	34.47±3.7	< 0.002
LVIDd	46.9±5.2	44.47± 5.5	< 0.022
LVIDs	30.6±5.3	28.64±5.1	< 0.047
IVSD	12.1±1.9	12.05±2.1	< 0.830
LVPWD	10.5±1.35	10.30±1.45	< 0.441
EF	64.4±5.7	63.38±5.42	< 0.375

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

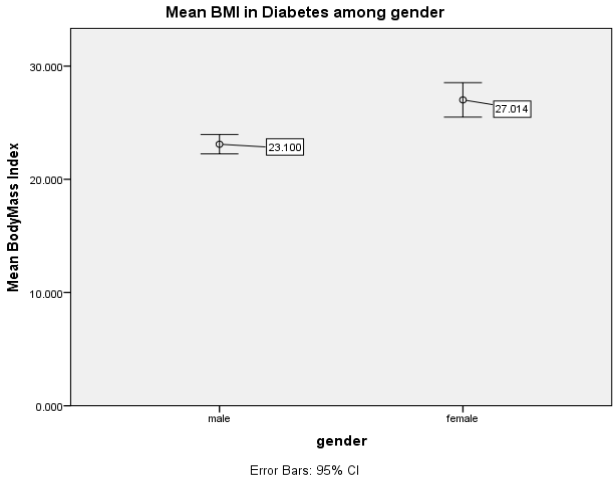

Figure 2: Compare mean of BMI between Diabetes patients in gender.

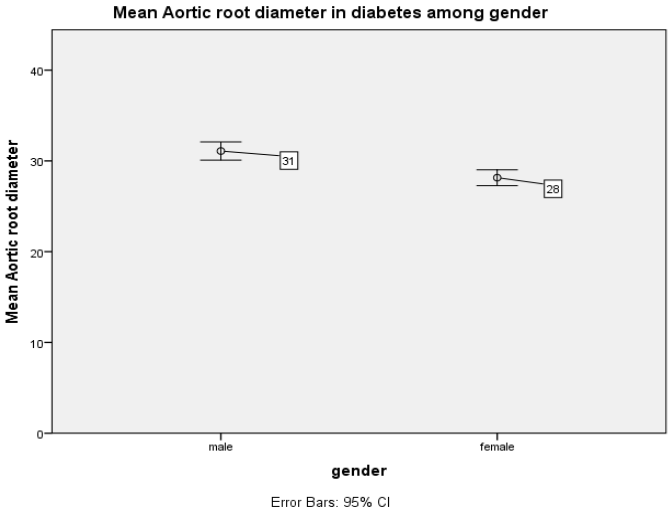

Figure 3: Error bar means of ARD for both gender

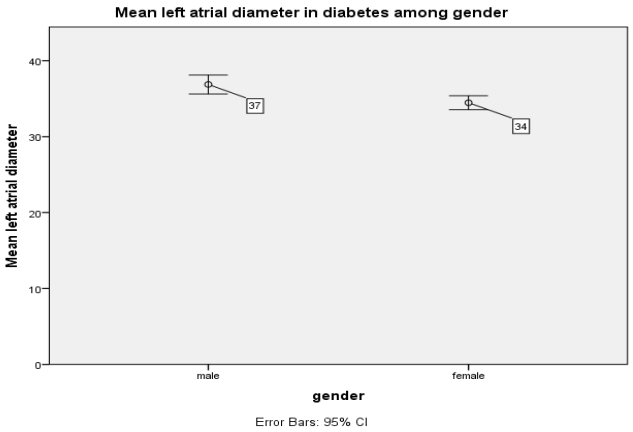

Figure 4: Compare means of atrial diameter between Diabetes patients according to gender

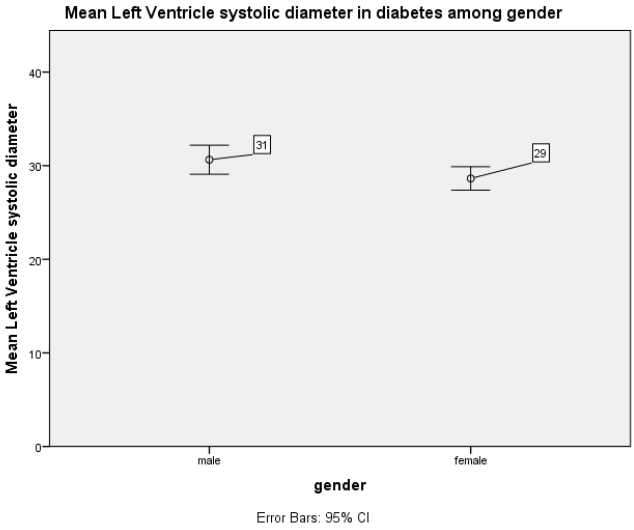

Figure 5: Compare Means of left ventricular systolic diameter between Diabetes patients according to gender

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 (23.09967Kg/m^2 ±2.898752) and (27.01367Kg/m^2 ±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 (44.47 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

[1] ADEOYE, A., ADEBIYI, A., OLADAPO, O., OGAH, O., AJE, A., OJJI, D., ADEBAYO, A., OCHULOR, K., ENAKPENE, E. & FALASE, A. 2012. Early diastolic functional abnormalities in normotensive offspring of Nigerian hypertensives. Cardiovascular journal of Africa, 23, 255.
[2] AIGBE, I. F., KOLO, P. M. & OMOTOSO, A. B. 2012. Left ventricular structure and function in black normotensive type 2 diabetes mellitus patients. Ann Afr Med, 11, 84-90.
[3] AKDEMIR, O., ALTUN, A., UĞUR ALTUN, B., ARıKAN, E. & TUĞRUL, A. 2001. Quantitative

Ultrasonic Myocardial Texture Analysis of the Diabetic Heart - Original Investigation. Anatol J Cardiol, 1, 17-21.

[4] ALWAN, F. J., ANMAR Z. SALEH & Y.AL-NAJJAR, H. 2014 Echocardiogrhphic assessment of the effect of type (2) Diabetes mellitus on cardiac performance.

[5] B.GERSH, J., S., K., M., B. M. & Y., S. 2010. The epidemic of cardiovascular disease in the developing world. global implications European Heart Journal Advance Access published February, 22.

[6] BAKRIS, G. L., FONSECA, V., KATHOLI, R. E., MCGILL, J. B., MESSERLI, F. H., PHILLIPS, R. A., RASKIN, P., WRIGHT, J. T., JR., OAKES, R., LUKAS, M. A., ANDERSON, K. M., BELL, D. S. & INVESTIGATORS, G. 2004. Metabolic effects of carvedilol vs metoprolol in patients with type 2 diabetes mellitus and hypertension: a randomized controlled trial. JAMA, 292, 2227-36.

[7] BENEDICT C., H. M., HATKE A., SCHULTES B., FEHM HL., BORN J., KERN W. 2004. Intranasal insulin improves memory in humans. Psychoneuroendocrinology, PMID.

[8] BLOMSTRAND, P., ENGVALL, M., FESTIN, K., LINDSTRÖM, T., LÄNNE, T., MARET, E., NYSTRÖM, F. H., MARET-OUDA, J., ÖSTGREN, C. J. & ENGVALL, J. 2015. Left ventricular diastolic function, assessed by echocardiography and tissue Doppler imaging, is a strong predictor of cardiovascular events, superior to global left ventricular longitudinal strain, in patients with type 2 diabetes. European Heart Journal-Cardiovascular Imaging, jev027.

[9] BOONMAN-DE WINTER, L., RUTTEN, F., CRAMER, M., LANDMAN, M., LIEM, A., RUTTEN, G. & HOES, A. 2012. High prevalence of previously unknown heart failure and left ventricular dysfunction in patients with type 2 diabetes. Diabetologia, 55, 2154-2162.

[10] BOYER, J. K., THANIGARAJ, S., SCHECHTMAN, K. B. & PEREZ, J. E. 2004. Prevalence of ventricular diastolic dysfunction in asymptomatic, normotensive patients with diabetes mellitus. Am J Cardiol, 93, 870-5.

[11] CHEUNG, N., WANG, J. J., KLEIN, R., COUPER, D. J., SHARRETT, A. R. & WONG, T. Y. 2007. Diabetic retinopathy and the risk of coronary heart disease: the Atherosclerosis Risk in Communities Study. Diabetes Care, 30, 1742-6.

[12] CORYA, B., S, R., SB, K. & H, F. 1975. Echocardiography in acute myocardial infarction Am J Cardiol 36, 1.

[13] DEVEREUX, R. B., ROMAN, M. J., DE SIMONE, G., O'GRADY, M. J., PARANICAS, M., YEH, J. L., FABSITZ, R. R. & HOWARD, B. V. 1997. Relations of left ventricular mass to demographic and hemodynamic variables in American Indians: the Strong Heart Study. Circulation, 96, 1416-23.

[14] FANG, Z. Y., NAJOS-VALENCIA, O., LEANO, R. & MARWICK, T. H. 2003. Patients with early diabetic heart disease demonstrate a normal myocardial response to dobutamine. J Am Coll Cardiol, 42, 446-53.

[15] GARDNER, D. G. S. & GREENSPAN, D. 2007. Greenspan's basic & clinical endocrinology, New York., McGraw Hill Companies

[16] IKE, S. & IKEH, V. 2006. The prevalence of diastolic dysfunction in adult hypertensive Nigerians. Ghana Med J, 40, 55-60.

[17] JAMESON, J. L. 2006. Harrison's endocrinology, New York, McGraw Hill Companies.

[18] LAWRENCE, J. M., CONTRERAS, R., CHEN, W. & SACKS, D. A. 2008. Trends in the prevalence of preexisting diabetes and gestational diabetes mellitus among a racially/ethnically diverse population of pregnant women, 1999–2005. Diabetes care, 31, 899-904.

[19] MANSOUR, R. A. 2014. Assessment of Helicobacter pylori Infection as a Risk Factor for Coronary Artery Disease in Gaza Strip. The Islamic University of Gaza.

[20] OSUNKWO, D. & BN, O. 2001. Left ventricular function in Nigerians with non-insulin-dependent diabetes mellitus. Am J Cardiol, 87, 1026-8.

[21] PATIL, V. C., PATIL, H. V., SHAH, K. B., VASANI, J. D. & SHETTY, P. 2011. Diastolic dysfunction in asymptomatic type 2 diabetes mellitus with normal systolic function. J Cardiovasc Dis Res, 2, 213-22.

[22] PHAM, I., COSSON, E., NGUYEN, M. T., BANU, I., GENEVOIS, I., POIGNARD, P. & VALENSI, P. 2015. Evidence for a Specific Diabetic Cardiomyopathy: An Observational Retrospective Echocardiographic Study in 656 Asymptomatic Type 2 Diabetic Patients. International Journal of Endocrinology, 2015, 743503.

[23] RAEV, D. 1994. Which LV function is impaired earlier in the evolution of diabetic cardiomyopathy? An echocardiographic study of young type I diabetic patients. Diabetes Care, 17 633-9.

[24] SAHN, D. J., DEMARIA, A., KISSLO, J. & WEYMAN, A. F. 1978. Recommendations regarding quantitation in M-mode echocardiography: results of a survey of echocardiographic measurements. Circulation, 58, 1072-1083.

[25] SOMARATNE, J., WHALLEY, G., POPPE, K., BALS, M. T., WADAMS, G., PEARL, A., BAGG, W. & DOUGHTY, R. 2011. Screening for left ventricular hypertrophy in patients with type 2 diabetes mellitus in the community. Cardiovascular Diabetology of the Journal, 29, 29.

[26] SRIVASTAVA, P. M., CALAFIORE, P., MACISAAC, R. J., PATEL, S. K., THOMAS, M. C., JERUMS, G. & BURRELL, L. M. 2008. Prevalence and predictors of cardiac hypertrophy and dysfunction in patients with Type 2 diabetes. Clin Sci (Lond), 114, 313-20.

[27] WERFALLI, M., MUSEKIWA, A., ENGEL, M. E., ROSS, I., KENGNE, A. P. & LEVITT, N. S. 2014. The prevalence of type 2 diabetes mellitus among older people in Africa: a systematic review study protocol. BMJ open, 4, e004747.

[28] ZABALGOITIA, M., ISMAEIL, M. F., ANDERSON, L. & MAKLADY, F. A. 2001. Prevalence of diastolic dysfunction in normotensive, asymptomatic patients with well-controlled type 2 diabetes mellitus. *American Journal of Cardiology,* 87**,** 320-323.

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.

Mr. Abdoelrahman Hassan Ali Bakry (Sudan) received the (B.Sc.) and (M.Sc.-1) in radiotherapy technology from College of Medical radiological Science, Sudan University of Science and Technology in 2013 and 2015 respectively. M.Sc.-2 (student) Diagnostic Radiology Technology, National University (Sudan)-2016. During 2013 up to date, he is staying in College of Medical radiological Science, Sudan University of Science and Technology, Radiology Department, Antalya Medical Center and Elnileen Diagnostic Medical Center; also he has been active in Computerized Texture Analysis, Radiotherapy-Oncology, and Diagnostic Radiology, Medical physics, ultrasound and Nuclear Medicine researches. Now he is lecturer at SUST also (2016).