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Evaluation of Echocardiographic Findings in Type II DM of North Indian Patients with or Without Cardiac Disease

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Abstract
The objective of our study was to determine whether there is statistically significant association between diastolic dysfunction in the asymptomatic and symptomatic (cardiac disease) subjects with type 2 diabetes mellitus and its relation to age, duration of DM, HbA1c, blood pressure, microalbuminuria and e GFR. In this cross-sectional study 90 subjects with type 2 diabetes were categorize in two groups after appropriate inclusion and exclusion criteria. Statistical analysis was done using SPSS 17.0. From this study we conclude that patients of type 2 diabetes mellitus without cardiac disease (asymptomatic) do have left ventricular diastolic dysfunction as well as left ventricular systolic dysfunction and this dysfunction increases with duration of diabetes mellitus, higher blood pressure, higher Hba1c levels and presence of albuminuria but has no significant correlation with eGFR. Strict watch and control of these parameters will help to delay the onset of cardiac disease in asymptomatic patients of type 2 diabetes mellitus.
Keywords- *Type 2 Diabetes mellitus, Diastolic dysfunction, Systolic dysfunction, Hba1c, microalbuminuria, eGFR.*

INTRODUCTION

Diabetes, an important metabolic disorder worldwide is classified as type 1 and type 2 diabetes, the former associated with insufficient insulin secretion from the beta cells in the pancreas, and the latter characterized by the phenomenon of insulin resistance with relative insulin deficiency

Type 2 diabetes mellitus is a leading cause of morbidity and mortality. Cardiovascular complications are known to be the main cause of death and morbidity in diabetic patients, as over 75% of all diabetic patients die from cardiovascular events[1] However, microvascular complications, such as kidney disease and retinopathy, are frequent and contribute to the total disease burden. The microvascular and macrovascular complications of diabetes are mediated primarily by atherosclerosis. Hyperglycemia causes vascular disturbances, especially endothelial dysfunction, contributed by

abnormal nitric oxide biology, increased endothelin and angiotensin 2, and reduced prostacyclin activity[2]. Diabetic dyslipidemia further contributes to the increased atherosclerotic risk. It is mainly due to increased low density lipoproteins (LDL), increased apolipoprotein B concentration, increased triglycerides and decreased high density lipoproteins (HDL)[3] The vascular effects of Advanced Glycosylation End Products (AGE s), circulating free fatty acids aggravate the systemic inflammation due to oxidative stress[4]. Diabetes leads to a prothrombotic milieu[5] with disturbances in platelet activation and aggregation, thus accelerating atherosclerosis.

As early as 1883, it was thought that patients of diabetes have increased incidence of heart Disease. Later studies confirmed these views. To date diabetes ranks as the 7th leading cause of death in western world (CDC, 1988). Heart involvement in Diabetes is as follows:

- Increased incidence & severity of atherosclerotic coronary artery disease.
- Cardiomyopathy.
- Autonomic dysfunction involving heart.
- Subclinical cardiac dysfunction.

Hypertension and coronary artery disease, known co-morbidities of diabetes, are established causes of heart failure. The most prominent risk factor for heart failure in diabetic patients is prior history of coronary artery disease. Furthermore, heart failure is more frequent in diabetic than in non-diabetic patients with myocardial ischemic injury[6]. Accumulating data from experimental, pathological, epidemiological and clinical studies have shown that diabetes causes changes within the cardiac structure and function, in the absence of coronary atherosclerosis, hypertension or any other known cardiac disease. However, the coexistence of myocardial ischemia, hypertension, and a specific diabetic cardiomyopathy seems to be independent but contributes to the biochemical, anatomic, and functional alterations in cardiac cells and tissues that impair cardiac function. Factors that can cause microvascular abnormalities, endothelial dysfunction, derangement of myocardial metabolism and autonomic neuropathy, such as hyperglycemia, hypertriglyceridemia and hypertension are postulated as etiological factors[7, 8-10].

Over the last three decades, a number of epidemiological, clinical and autopsy studies have proposed the presence of diabetic heart disease as a distinct clinical entity (Rubler et al.[11], 1972, Fein[12] , 1985,). Diastolic heart failure (HF) is also referred to as HF, with preserved left ventricular systolic function. Several Studies have reported a high prevalence of diastolic dysfunction among asymptomatic subjects with DM[13]. The evidence indicates that myocardial damage in diabetic subjects affects diastolic function before the systolic function. The most important mechanisms of diabetic cardiomyopathy are metabolic disturbances (increased free fatty acids, carnitine deficiency, changes in calcium homeostasis), myocardial fibrosis (increases in angiotensin II, IGF-I, and inflammatory cytokines), small vessel disease (microangiopathy, impaired coronary flow reserve, and endothelial dysfunction), cardiac autonomic neuropathy (denervation and alterations in myocardial catecholamine levels), and insulin resistance (hyperinsulinemia and reduced insulin sensitivity)[19.]

Left ventricular diastolic dysfunction represent the reversible first stage of diabetic cardiomyopathy, reinforcing the importance of early examination of diastolic ventricular function in individuals with diabetes. According to Virendra C. Patil study overall prevalence of diastolic dysfunction was 54.33% in asymptomatic type 2 DM subjects. Similarly Nikhil M Dikshit et al concluded that diastolic dysfunction in patients of diabetes is present in 66% of patients even when diabetes is present at a younger age, and is of a shorter duration. So far, very few population-based studies have been carried out in North India.

The objective of our study was to determine whether there is statistically significant association between diastolic dysfunction in the asymptomatic and symptomatic (cardiac disease) subjects with type 2 diabetes mellitus and its relation to age, duration of DM, HbA1c, blood pressure, microalbuminuria and e GFR.

MATERIAL & METHODS

A cross- sectional study of ninety subjects with type II diabetes mellitus as classified by WHO criteria(1985), attending the General Medicine OPDs, Diabetes Clinic, Medical Wards of the LLR Hospital associated hospitals, GSVM Medical College Kanpur from Jan. 2014 to June 2015 were included in the study. Follow up patients of categorical Diabetes Mellitus were also included in the study. Other patients were subjected to random blood glucose examination and those who had abnormal random blood glucose levels were subjected to oral glucose tolerance test; 75 g of glucose was given to these subjects after an overnight fast and then fasting and postprandial venous plasma glucose concentrations were measured by the glucose oxidase method.

Criteria for Diabetaes Mellitus Type-2:

Fasting plasma sugar > 126 mg/dl on two separate occasions, Post Prandial Plasma > 200 mg/dl on two separate occasions and HbA1C level >6.5.

Selection Criteria:

***Group A*:** Patients of Type-2 Diabetes Mellitus with signs and symptoms of Cardiac disease. (n=30)

Group B: Patients of Type-2 Diabetes Mellitus without signs and symptoms of Cardiac disease. (n=60).

Exclusion Criteria:

1. Patients of type I Diabetes Mellitus.
2. Patients with diabetic end stage renal disease
3. Patients with rheumatic, valvular Heart disease
4. Patients with pregnancy, UTI and any other condition causing proteinuria
5. Patients with congenital heart disease.

Methods

A detail clinical history of patients was recorded and thorough physical examination including blood pressure was done by an experienced physician.

PLAN OF INVESTIGATIONS

Routine investigations including: Hb%, TLC, DLC, ESR, GBP, Serum creatinine, e GFR, Urine routine and microscopy and urine for albuminuria.

Specific Investigations: X-ray Chest PA View, 12 Lead Standard Electrocardiogram, Measurement of HbA1C level and fasting lipid profile.

Examination of Fundi Oculi

Echocardiography- It was performed at LPS Institute of Cardiology using Hewlett Packard Ultrasound imaging system (Model 7700 AC) using 3.5/2.5 MHz phase array transducer. Appropriate precautions were taken to maintain accuracy of imaging. Subjects were examined in the left lateral decubitus and supine position using standard parasternal long axis, short axis and apical views. All recordings and measurements were obtained by the same observer according to the recommendations of the American Society of Echocardiography4 and were always performed at midday to avoid the influence of circadian rhythm on left ventricular diastolic function. Pulsed-wave Doppler (PWD)-derived transmitral inflow velocities were obtained in the apical 4-chamber view, with the sample volume placed at the mitral valve leaflet tips. Measurements included the transmitral early diastolic rapid filling (E-wave) and atrial contraction late filling (A-wave) velocities to calculate E/A ratio, isovolumteric relaxation time (IVRT) and deceleration time (DT). For tissue Doppler imaging, the mitral annulus velocity was obtained with a 2 mm sample volume placed at the lateral side and septal side of the mitral annulus. Diastolic dysfunction was labelled according to the standard guidelines. Left ventricular overall ejection fraction (systolic function) was calculated by modified Simpson's method; and, LVEF $\geq$ 50% was considered as normal. All echocardiographic measurements were averaged over three consecutive cardiac cycles, measured by a single investigator blinded to all other variables

EXERCISE TESTING: It was performed at the LPS Institute of Cardiology. Patients were thoroughly evaluated clinically for fitness for exercise testing and patients with any contraindication to exercise testing were not given this test. Testing involved standard Bruce protocol with initial warm up phase. Heart rate, blood pressure & ECG were taken before, during & for 5 min. after exercise at every one minute. Patient was asked to report any symptoms that he felt. Duration of exercise was also noted for every patient. Exercise test was equipped with Echocardiography & phonocardiographic examination.

Estimation of Microalbuminuria:
Microalbuminuria was established using Randoxkit.

Calculation of GFR- In adults, the best equation for estimating glomerular filtration rate (GFR) from serum creatinine is the isotope dilution mass spectrometry (IDMS)-traceable Modification of Diet in Renal Disease (MDRD) Study equation. This IDMS-traceable MDRD study equation calculator is for use with S_{cr} reported in mg/dL.

GFR (mL/min/1.73 m^2) = 175 × $(S_{cr})^{-1.154}$ × $(Age)^{-0.203}$ × (0.742 if female) × (1.212 if African American) (conventional units).

Statistical Analysis
The data was compiled and analysed using SPSS 17.0. Data was compared using percentages. Chi square test for proportions was applied to assess the association between categorical variables. Two tailed p-values < 0.05 were considered significant.

Results
In the present study ninety cases of type 2 diabetes mellitus were taken and were divided into two groups:

Group – A: Patients of type II diabetes mellitus with signs and symptoms of cardiac disease (n=30)

Group – B: Patients of type II diabetes mellitus without signs and symptoms of cardiac disease (n=60)

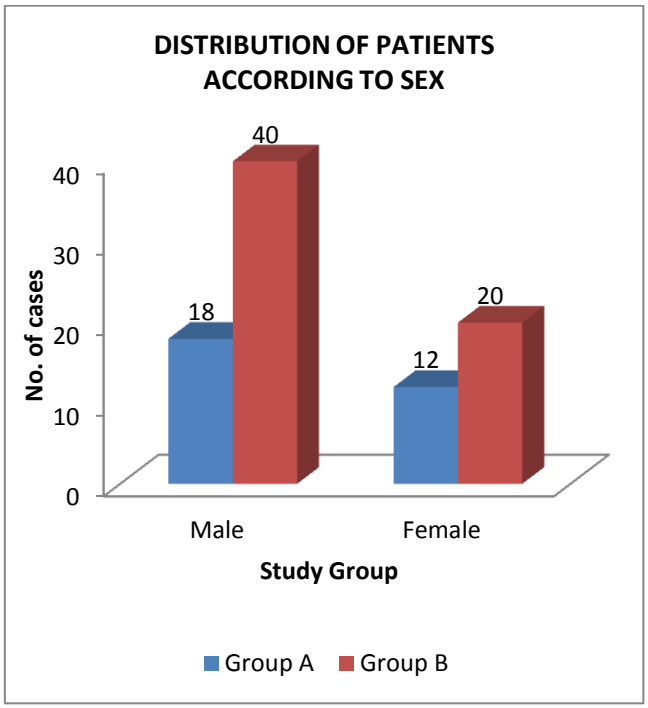
These patients were also investigated for microalbuminuria and S.Creatinine for calculation of e GFR.

Out of ninety cases 58 cases were males and 32 cases were females. In both the groups males outnumbered the females as shown in the table given below:

Table I: Distribution of patients according to Sex

Study Group	Male		Female	
	No. of cases	Percentage	No. of cases	Percentage
GROUP A	18	60.0	12	40.0
GROUP B	40	66.6	20	33.3

Graph 1: Distribution of patients according to Sex



In our study majority of the patients in group A (type 2 DM with cardiac disease) were in the age group of 56 – 65 years (40%) followed by the age group of 66 – 75 years(33.3%) as shown in the given table -2. In contrast to this majority of patients in group B (Type 2 DM without cardiac disease) were two decades younger than that of group A.

Table–2: Distribution of patients according to age

Age Group (Yrs)	Group A		Group B	
	No. of cases	Percentage	No. of cases	Percentage
25 – 35	-	-	04	06.6
36 – 45	-	-	24	40.0
46 – 55	08	26.6	20	33.3
56 – 65	12	40.0	12	20.0
66 – 75	10	33.3	-	-

40% patients in group B lie in between age group (36-45) followed by age group (46– 55) years (33.3%)

Graph 2 - Distribution of patients according to age.

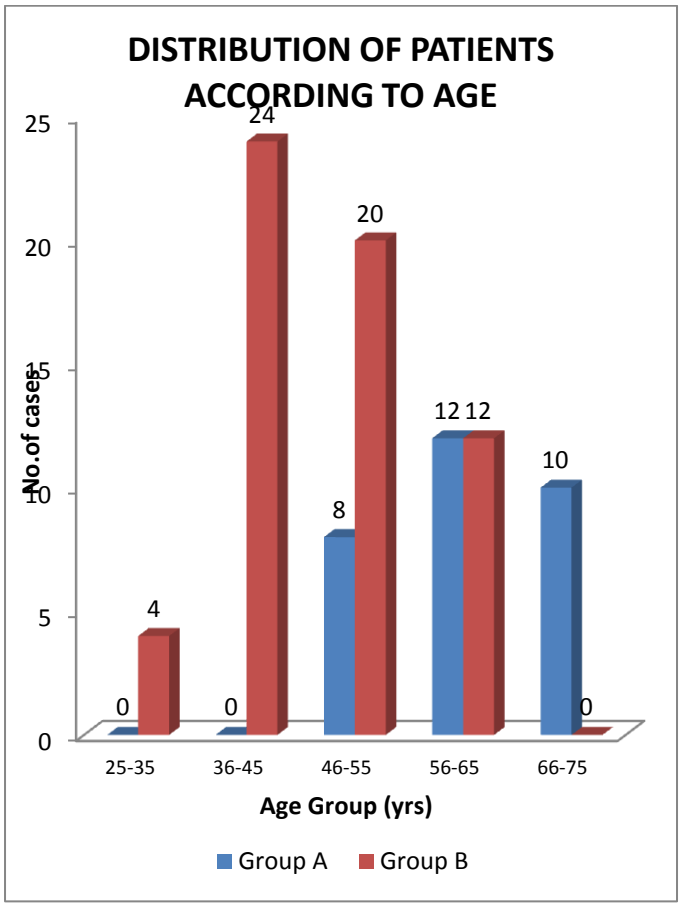


Table 3:- Distribution of Blood pressure

Blood pressure	Group A		Group B		probability
>140/90 mm/Hg	20	66.6%	16	26.6%	P = 0.001
<140/90 mm/Hg	10	33.3%	44	73.3%	

In Group A 66.6 % patients had increased blood pressure >140/90 mm/ Hg and 33.3 % patients had a blood pressure of <140/90 mm/ Hg. Group B 26.6 % patients had increased blood pressure >140/90 mm/ Hg and 73.3 % patients had a blood pressure of <140/90 mm/ Hg.

The association between blood pressure and presence of cardiac manifestations was statistically significant.

Graph 3:- Distribution of Blood pressure

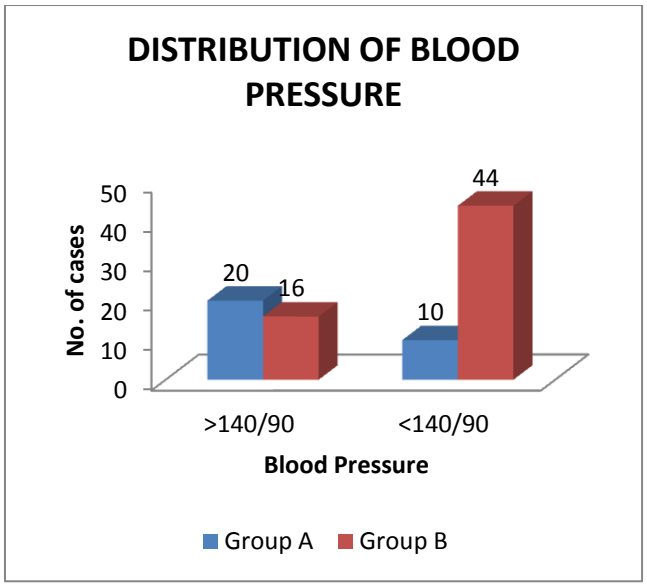


Table 4 shows that in Group A 40% patients had higher cholesterol and 60% had a normal cholesterol level, In Group B 6.6% patients had higher cholesterol and 93.3% had a normal cholesterol level.

In Group A 33.3% patients had higher triglyceride levels and 66.6% had a normal triglyceride level whereas in Group B 13.3% patients had higher triglyceride levels and 86.6% had a normal triglyceride levels.

In Group A 46.6% patients had lower HDL levels and 53.3% had a normal HDL levels, In Group B 10% patients had lower HDL levels and 90% had a normal HDL levels.

Table 4:- Distribution of lipid profile

		GROUP A		GROUP B	
Cholesterol	>250 mg/dl	12	40%	4	6.6%
	<250 mg/dl	18	60%	56	93.3%
TG	>200 mg/dl	10	33.3%	8	13.3%
	<200 mg/dl	20	66.6%	52	86.6%
HDL	<40 mg/dl	14	46.6%	6	10%
	>40 mg/dl	16	53.3%	54	90%
LDL	>100 mg/dl	16	53.3%	12	20%
	<100 mg/dl	14	46.6%	48	80%

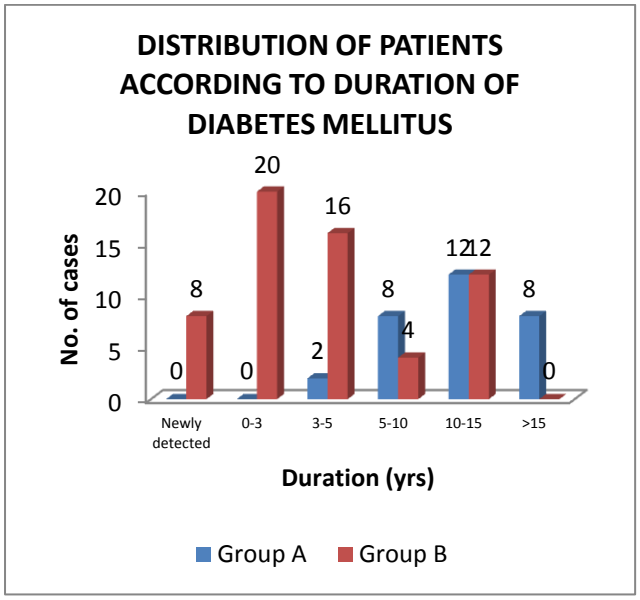
In Group A 53.3% patients had higher LDL levels and 46.6% had a normal LDL levels, In Group B 20% patients had higher LDL levels and 80% had a normal LDL levels.

In Group A majority of patients (66.6%) had duration of Type II DM more than 10 years whereas in Group B majority of patients (80.0%) had duration of disease less than 10 years.

Table No. 5: Distribution of patients according to duration of diabetes mellitus

Duration (yrs)	Group A		Group B	
	No. of cases	**Percentage**	**No. of cases**	**Percentage**
Newly detected	-	-	08	13.3
0 – 3	-	-	20	33.3
3 – 5	02	06.6	16	26.6
5 – 10	08	26.6	04	06.6
10 – 15	12	40.0	12	20.0
>15	08	26.6	-	-

Graph 4: Distribution of patients according to duration of diabetes mellitus.



All the patients in group A had ECG changes whereas only 30% patients in Group B had ECG changes as given below.

Table 6: Distribution of patients according to ECG manifestations

ECG Changes	Group A		Group B	
	No. of cases	Percentage	No. of cases	Percentage
LVH	10	33.3	06	10
LAE	06	20.0	-	-
LAD	12	40.0	12	20
RVH	04	13.3	-	-
ST-Depression	02	06.6	-	-
ST-Elevation	02	06.6	-	-

Above Table shows that in Group A maximum number of patients (40%) had left axis deviation, 33.3% patients showed left ventricular hypertrophy, 20% patients demonstrated left atrial enlargement, 30.3% patients showed changes of right ventricular hypertrophy and only 6.6% patients showed ischemic changes in ECG.

In Group B only 10% patients showed left axis deviation and 20% patients showed left ventricular hypertrophy in ECG.

In this study maximum patients (33.3%) in Group A had got a EF in between 56 – 60 where as 20% patients had got EF in between 41 – 45%, 13.3% patients had got EF in between 51 – 55%, 6.6% patients had got EF in between 35 – 40% and 6.6% patients had got EF > 60%.

Table 7: Observations of ejection fraction at rest by echocardiography in study group

Ejection Fraction (%)	Group A		Group B	
	No. of cases	Percentage	No. of cases	Percentage
35 – 40	02	06.6	-	-
41 – 45	06	20.0	-	-
46 – 50	04	13.3	-	-
51 – 55	06	20.0	12	20.0
56 – 60	10	33.3	36	53.3
>60	02	06.6	16	26.6

In Group B none of the patients had EF < 50%. Majority of the patients (53.3%) had got EF in between 56 – 60%, 26.6% patients had got EF > 60% and 20% patients had got EF in between 51 – 55%.

Majority of the patients (80%) had E/A ratio decreased. This shows the diastolic dysfunction in these patients. 53.3% patients had increased end systolic volume of left ventricle, 40.0% patients had increased left ventricle internal diameter in systole, 33.3% patients had increased left ventricle internal diameter in diastole and 33.3% patients had increased left atrium dimension.

Table 8: Observations of Echocardiographic measurements in study group

Parameters	No. of cases Size/Volume	Changes	Group A		Group B	
			No. of cases	Percentage	No. of cases	Percentage
LA	12 – 35mm	Increased	10	33.3	-	-
LVIDs	22 – 43mm	Increased	12	40.0	04	06.6
LVIDd	42 – 60mm	Increased	10	33.3	04	06.6
EDVLV	85 – 150mm	Increased	08	26.6	-	-
ESVLV	25-60ml	Increased	16	53.3	-	-
E/A Ratio	-	Decreased	24	80.0	24	40.0

Whereas In Group B 40.0% patients had E/A ratio decreased. This shows the diastolic dysfunction in these patients. Only 6.6% patients had increased left ventricle internal diameter in systole and diastole.

In Group A, 60.0% patients had positive stress test. Only 33.3% patients had achieved heart rate more than 85% of maximum heart rate. 60.0% faced chest discomfort during exercise. 26.6% patients got SBP below 120 mm of Hg during whole exercise and 13.3% patients could not be able to do exercise.

Table 9: Observation of Tread Mill testing in study group

Observations	Group A		**Group B**	
	No. of cases	Percentage	No. of cases	Percentage
Stress test positive	18	60.0	04	06.6
Cases who had >85% of max predicted HR	10	33.3	60	100
Patients having SBP <120 mm of Hg during exercise or fall in BP more than 10mm of Hg from resting B.P.	08	26.6	-	-
Chest discomfort	18	60.0	04	06.6
Patients not able to do exercise	04	13.3	-	-

In Group B (without cardiac disease) 100% patients achieved maximum heart rate more than 85%, 6.6% patients had positive stress test and 6.6% faced chest discomfort during exercise.

Table 10:- HbA1C level in both the groups

HbA1C level (g %)	Group A		Group B		Probability
>6.5	20	66.6%	20	33.3%	P = 0.006
<6.5	10	33.3%	40	66.6%	

In Group A 66.6% had HbA1C level >6.5 and 33.3% patients had HbA1C level <6.5, In Group B 33.3% had HbA1C level >6.5 and 66.6% patiens had HbA1C level <6.5.

The association between HbA1C level and presence of cardiac manifestations was statistically significant.

Graph 5:- HbA1C level in both the groups

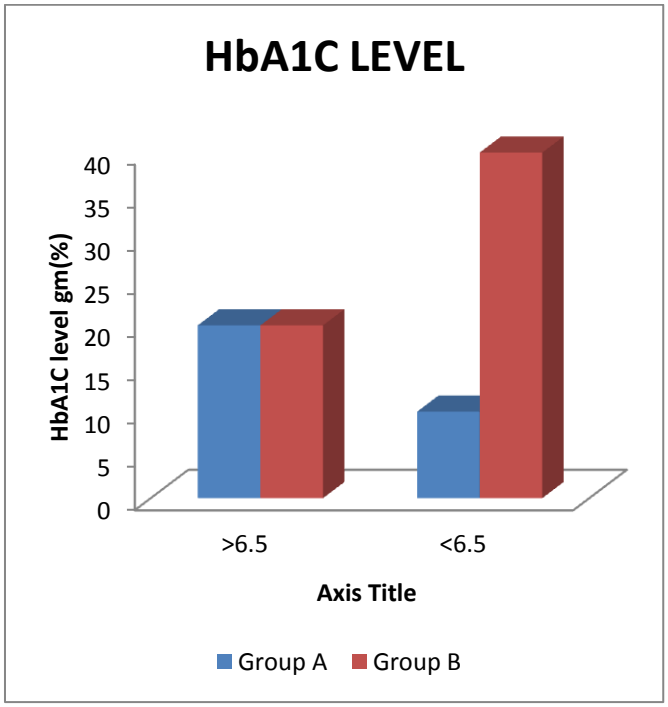


Table 11:- Albuminuria in relation to presence of cardiac manifestations

Urinary albumin	Group A		Group B		Probability
>30mg/dl	14	46.6%	10	16.6%	P=0.005
<30mg/dl	16	53.3%	50	83.3%	

In Group A 46.6% patients had urinary albumin >30mg/dl and 53.3% patients had <30mg/dl, In Group B 16.6% patients had urinary albumin >30mg/dl and 83.3% patients had <30mg/dl.

The association between albuminuria and presence of cardiac manifestations was statistically significant.

Graph 6:- Albuminuria in relation to presence of cardiac manifestations

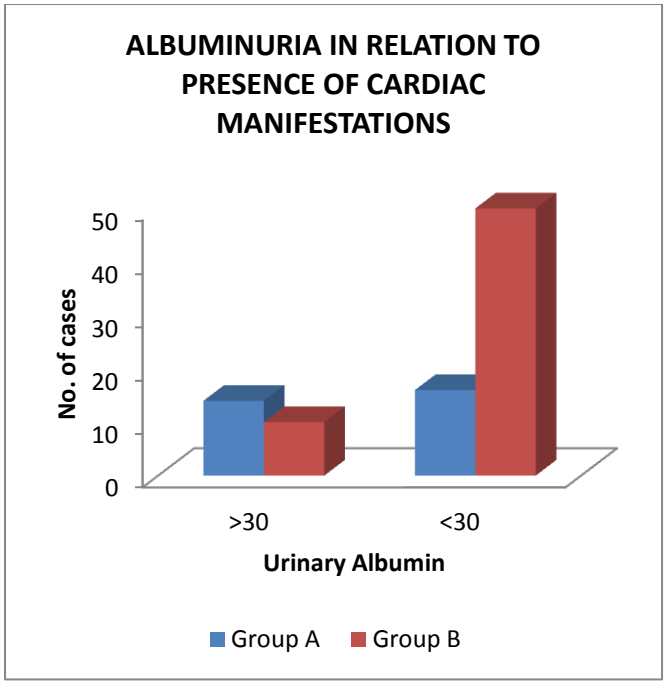
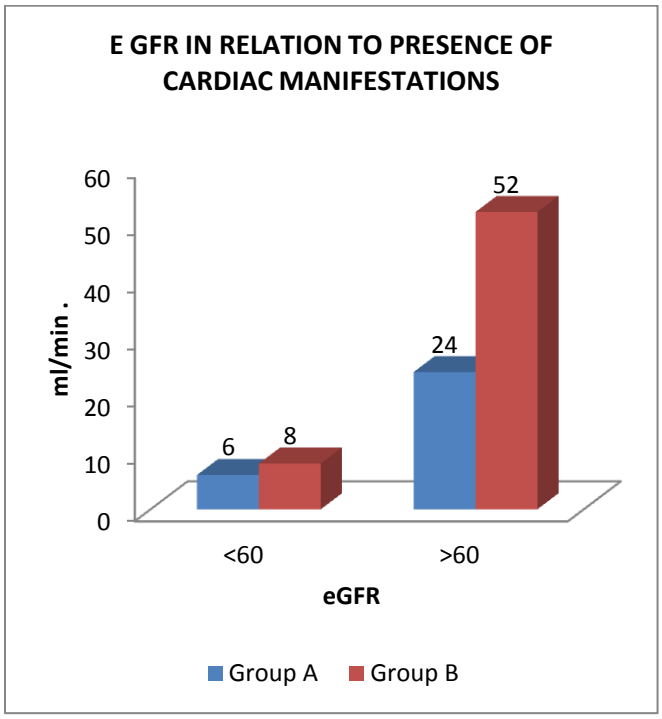


Table 12:- e GFR in relation to presence of cardiac manifestations

e GFR	Group A		Group B		Probability
<60ml/min.	6	20%	8	13.3%	P = 0.607
>60ml/min.	24	80%	52	87.6%	

In group A 20 % patients had prevalence of e GFR <60 ml/min and Group B 13.3% patients had prevalence of e GFR <60 ml/min. Prevalence of e GFR <60 ml/min in diabetic patients in this study is 15.5%. The association between e-GFR and presence of cardiac manifestations was not statistically significant.

Graph 7:- e GFR in relation to presence of cardiac manifestations



DISCUSSION

This study was conducted at LLR and associated hospitals, GSVM Medical College Kanpur. Ninety Patients were taken from General Medicine OPDs, Diabetes Clinics, and Medical wards of LLR Hospital employing appropriate inclusion and exclusion criteria. Their diabetic status was confirmed and they were categorized as per WHO 1985 criteria and grouped subsequently.

Group A: Patients of Type -2 Diabetes Mellitus with signs and symptoms of Cardiac disease [n=30]

Group B: Patients of Type -2 Diabetes Mellitus without signs and symptoms of Cardiac disease [n=60]

Age distribution

In our study Maximum number of patients in group A lie in the age group 55-65 years while maximum number of group B patients lie in age group 45-55 years .So this shows that as the age increases in diabetics, diabetic patients become more vulnerable

for cardiac diseases. Inoguchi T, et al. (2000 JAN.)[26] has found that elderly NIDDM patients (age over 60 years) had an extremely high prevalence (estimated 26.3%) of silent myocardial ischemia become more vulnerable. This evidence suggests that early and intensive detection may be needed as a part of routine care for this group.

Sex distribution

Majority of patients were male in group A & B, since this study drew patients coming to a tertiary level hospital, it was expected that male patients outnumber female patients. The pattern is distributed through the both groups. Slight dominance of male patients in number may be a reflection of their openness to visit hospital and may reflect sex distribution in employement, since many of patients visiting our hospital are public sector employees.

Framingham heart study (1974) - In this prospective study of 5000 individuals over an 18 year follow up period , the frequency of congestive heart failure was more than twice as high in diabetec men than in the nondiabetic cohort, while it was increased fivefold in diabetic women.

Duration of disease

Majority of patients 66.6 % in group A had duration of diabetes mellitus more than 10 years. While in group B 70 % patients had duration of diabetes mellitus less than 10 years.

Hamby et al. (1974) noted an increased incidence of diabetes in patients with idiopathic cardiomyopathy. He had done study on 73 patients in which he found the duration of diabetes in affected subjects were quite variable, ranging from less than 1 year to 11 years.[15]

Blood pressure

In patients with cardiac disease 66.6% patients had increased blood pressure >140/90 mm/Hg and 33.3% patients had a blood pressure of <140/90 mm/Hg. Patients without cardiac disease 26.6% patients had increased blood pressure >140/90 mm/Hg and 73.3% patients had a blood pressure of <140/90 mm/Hg. Estacio RO et al. shows that use of antihypertensive in patients of diabetes decreases the risk of CAD[17.]

Glycemic control

In Group A 66.6% had HbA1C level >6.5 and 33.3% patients had HbA1C level <6.5, In Group B 33.3% had HbA1C level >6.5 and 66.6% patients had HbA1C level <6.5. The Honolulu Heart Study[18,] the Bedford Study[19,] and the Pathological Determinants of Atherosclerosis in Youth Study [20] are some of the studies that have demonstrated the association of hyperglycemia with CAD. Reduction of CAD events with intensive glycemic control using insulin was shown in the randomized trial of insulin–glucose infusion followed by subcutaneous insulin treatment in diabetes patients with acute MI, which indirectly proves the association of hyperglycemia with CAD.

Lipid profile

In Group A 40% patients had higher cholesterol and 60% had a normal cholesterol level, In Group B 6.6% patients had higher cholesterol and 93.3% had a normal cholesterol level. In Group A 33.3% patients had higher triglyceride and 66.6% had a normal triglyceride level, In Group B 13.3% patients had higher triglyceride and 86.6% had a normal triglyceride level. In Group A 46.6% patients had lower HDL and 53.3% had a normal HDL level, In Group B 10% patients had lower HDL and 90% had a normal HDL level. In Group A 53.3% patients had higher LDL and 46.6% had a normal LDL level, In Group B 20% patients had higher LDL and 80% had a normal LDL level.

Rajmohan L, et al[21]. showed that the prevalence of CAD was significantly higher among patients with isolated hypercholesterolemia, isolated high LDL, and isolated low HDL cholesterol compared to normolipidemic individuals, but not in those with isolated hypertriglyceridemia.

ECG manifestations in both groups

Most of the patients in group A 33.3% had got left ventricular hypertrophy. 40% patients in Group A had got left axis deviation. 13.3% patients had got right ventricular hypertrophy. 20% patients had got

left atrial enlargement ECG shows the changes of cardiomyopathy in these patients. Only 13.3% patients showed ischemic changes in resting ECG and only 13.3% developed MI showing ST elevation. In Group B only 10% patients had developed left ventricular hypertrophy and only 20% patients had developed left axis deviation.

Echocardiographic Measurements

In their pioneering study done on patients of cardiomyopathy, Robert Hamby and co-workers (1974) found a significantly increased association with diabetes[15.] They noted that LV end diastolic volume at rest was abnormally increased in diabetic patients. They did not index it to body surface area but this was statistically significant.

Zoneraich et al[27]. **1977** found LV end systolic volume in diabetes without clinical heart disease to be higher than controls but this was not statistically significant.

Left ventricular end diastolic volume (134± 22.1ml) in patients with signs and symptoms of cardiac disease was higher than patients without signs and symptoms of cardiac disease (118±20.2ml). This was statistically significant (P = 0.032).

Left ventricular end systolic volume (51.2±10.4ml) in patients with signs and symptoms of cardiac disease was higher than patients without signs and symptoms of cardiac disease (41.4±9.2ml). This was statistically significant (P = 0.032).

Shapiro et al. 1980in their work involving patients of all types of diabetes mellitus reported that diabetic patients had significantly increased LV end diastolic dimension and systolic dimension as compared to controls (53+-9mm, 45+-4mm, P < 0.001). As is obvious from table 7during systole left ventricular internal diameter was significantly higher in patients with signs and symptoms of cardiac disease than asymptomatic patients (P = 0.001, highly significant)[22,23.]

During diastole left ventricular internal diameter was significantly higher in patients with signs and symptoms of cardiac disease than the patients without signs and symptoms (P = 0.041).

Bouchard et al. 1989 studying both types of diabetics who were asymptomatic and normotensive but not necessarily free from CAD reported a decrease in E/A which was independent of age of patients or duration of diseases[24.]

Both type of diabetic patients Group A and Group B had diastolic dysfunction in most of the patients. 33.3 % patients in Group A had got increased left atrial size. In Group B only 6.6 % patients had increased left ventricular internal diameter in systole and diastole.

Tread Mill Testing

60% patients of Group A had positive tread mill test that is development of ≥ 0.1 mv (1 mm) of J point depression measured from the PQ junction with relatively flat or flat slopping ST segment slope depressed ≥ 0.1 mv, 80 msec. after the J point in three consecutive beats. While in Group B 6.6% cases had got positive stress test results. In Group A only 33.3 % patients had achieved maximum heart rate > 85% of predicted value. While in Group B 100% patients had achieved heart rate of > 85% of predicted value. In Group A 60% patients faced chest discomfort during exercise. While in Group B 6.6 % patients had faced chest discomfort during exercise. In Group A 26.6% patients had got systolic blood pressure below 120mm Hg during exercise or fall in blood pressure >10mm of Hg from normal resting blood pressure during exercise. This suggests that their stroke volume was so low that they were not able to achieve systolic blood pressure more than 120 mm of Hg. While in Group B every patient had achieved blood pressure > 120mm of Hg. Positive stress test implies that patients had got significant coronary artery disease.

Sasaki A,(1999 APRIL)[28] had found the frequency of IHD in the group (n=22, 36.4) with microalbuminuria that was significantly (p<0.03) higher than those (n=38, 10.5%) with normoalbuminuria. We concluded that the measurement of urinary albumin is important when approaching diabetic macroangiopathy.

Ejection Fraction

In Group A majority of patients (60%) had ejection fraction less than 55%. While in Group B 80% patients had got ejection fraction more than 55%. Ejection fraction was lowered in Group A because of impaired systolic performance of the left

ventricle due to cardiomyopathy. Cardiomyopathy can be because of two reasons: (i) Ischemic (ii) Diabetes alone can cause interstitial fibrosis and leads to cardiomyopathy without atherosclerosis.

Hamby et al. (1974)[15] noted that diabetics had lower ejection fraction at rest but their work includes only 12 patients including the patients of coronary artery disease. Zoneraich et al[27] (1977) observed lower ejection fraction in diabetic patients but this difference was not significant.

In a controlled study done by **Senevitarne** et al. (1977), it was shown that diabetic patients with evidence of microangiopathy had significantly lower fractional shortening as compared to control group. **Shapiro** et al. (1980)[22] & **Abenovoli**e T al. (1981)[25] reported of similar findings.

Microalbuminuria

Sasaki A, et al.(1999 APRIL)[28] had found the frequency of IHD in the group (n=22, 36.4) with microalbuminuria was significant (p<0.03) higher than those (n=38, 10.5%) with normoalbuminuria.

In Group A 46.6% patients had urinary albumin >30mg/dl and 53.3% patients had <30mg/dl, In Group B 16.6% patients had urinary albumin >30mg/dl and 83.3% patients had <30mg/dl

e GFR

In group A 20 % patients had prevalence of e GFR <60 ml/min and Group B 13.3% patients had prevalence of e GFR <60 ml/min. Prevalence of e GFR <60 ml/min in diabetic patients in this study is 15.5%. The association between e-GFR and presence of cardiac manifestations was not statistically significant.

CONCLUSION

From our study we conclude that majority of the patients having signs and symptoms of cardiac disease lie in elderly age group i.e. more than 60 years. While majority of the patients not having signs and symptoms of cardiac disease lie in age group less than 50 years.

In both type of diabetics majority of patients were male genders. That can only be explained by their more openness to visit hospitals.

66.6% patients of having signs and symptoms of cardiac disease had duration of diabetes mellitus more than 10 years. While 80% of patients without having any feature of cardiac disease had duration less than 10 years.

In ECG, patients with signs and symptoms of cardiac disease showed left ventricular hypertrophy in 33.3% cases but only by seeing left ventricular hypertrophy in ECG it is very difficult to comment on dilatation or hypertrophy. 6.6 % patients showed ischemic changes (i.e. ST depression) in resting ECG.

Both groups showed diastolic dysfunction in echocardiography.

Left ventricular internal diameter during systole in patients with signs and symptoms of cardiac disease (38.26 ± 8.4) was greater than patients without signs and symptoms of cardiac disease (30.4 ± 5.7mm). This difference was statistically significant (p=0.001).

Left ventricular internal diameter during diastole in patients with signs and symptoms of cardiac disease (55 ± 9.7mm) was greater than patients without signs and symptoms of cardiac disease (50 ± 5.4mm). This difference was statistically significant (p = 0.041).

End systolic volume of left ventricle was higher in patients with signs and symptoms of cardiac disease (51.2 ± 10.4ml) than patients without signs and symptoms of cardiac disease (41.4 ± 9.2ml). This difference was statistically significant (p = 0.011).

End diastolic volume of left ventricle was higher in patients with signs and symptoms of cardiac disease (134 ± 22.1ml) than patients without signs and symptoms of cardiac disease (118 ± 20.2ml). This difference was statistically significant (p = 0.03).

13 patients with signs and symptoms of cardiac disease had undergone tread mill testing. This test was positive in 60% cases.13.3% patients were not able to do exercise because of some contraindi-cations. 26.6% patients had systolic blood pressure below 120mmHg during whole exercise in patients with signs and symptoms of cardiac disease.

60% patients with cardiac disease had ejection fraction below 50% whereas only 20% patients

without cardiac disease had ejection fraction between 51 - 55% and none below 50%.

Blood pressure was higher in patients with signs and symptoms of cardiac disease than patients without signs and symptoms of cardiac disease. The association between blood pressure and presence of cardiac manifestations was statistically significant (p=0.001).

HbA1C level was higher in patients with signs and symptoms of cardiac disease than patients without signs and symptoms of cardiac disease. The association between HbA1C level and presence of cardiac manifestations was statistically significant (p=0.006).

e GFR(<60ml/min) was higher in patients with signs and symptoms of cardiac disease than patients without signs and symptoms of cardiac disease. The association between e GFR and presence of cardiac manifestations was statistically not significant (p=0.607).

Albuminuria was higher in patients with signs and symptoms of cardiac disease than patients without signs and symptoms of cardiac disease. The association between Albuminuria and presence of cardiac manifestations was statistically significant (p=0.005).

So from this we conclude that patients of type 2 diabetes mellitus without cardiac disease (asymptomatic) do have left ventricular diastolic function as well as left ventricular systolic dysfunction and this dysfunction increases with duration of diabetes mellitus, higher blood pressure, higher Hba1c levels and presence of albuminuria but not with eGFR. Strict watch and control of these parameters will help to delay the onset of cardiac disease in asymptomatic patients of type 2 diabetes mellitus.

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