

## Original Research Article

# Silhouette of cardiac impairment in diabetic patients at a medical college in Rewa district

Julie Abraham<sup>1</sup>, Manoj Indurker<sup>2</sup>, Seema Mahant<sup>3</sup>, M. K. Jain<sup>2</sup>, Kanniyar Binub<sup>4\*</sup>

<sup>1</sup>Department of General Medicine, District Hospital, Garacharma, Portblair

<sup>2</sup>Department of General Medicine, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

<sup>3</sup>Department of General Medicine, Government Medical College, Datia, Madhya Pradesh, India

<sup>4</sup>Department of Community Medicine, Malabar Medical College Ulliyeri, Kerala, India

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**\*Correspondence:**

Dr. Kanniyar Binub,

E-mail: kanniyarbinub@gmail.com

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### ABSTRACT

**Background:** The modern technology (TMT) had helped to detect cardiac impairment in diabetes patients relative to past. This study had attempted to use modern tools for detection of cardiac impairment in patients who attended OPD in a medical college of Rewa district. Objectives of the study was to evaluate cardiac dysfunction and factors associated with cardiac dysfunction (using values of TMT) in diabetic patients.

**Methods:** A descriptive study was done with help of recording history of variables like smoking, alcohol, BMI, HBA1C value, cholesterol level and others. Chi square was done to assess test of significance.

**Results:** Diastolic dysfunction was more in patients with diabetic complications than those without diabetic complications. Most patients having peripheral neuropathy, nephropathy and retinopathy had diastolic dysfunction. Patients had also shown high incidence of positivity to TMT. Half of the patients (50%) positive results for stress test were higher with cases who led a sedentary life style (13.64%). Most of patients (70%) had serum. cholesterol level less than 200 mg/dl but the positive results for stress test were higher in patients with Serum. cholesterol level 200 to 239 mg/dl.

**Conclusions:** The study could shower light on the conclusion that left ventricular diastolic dysfunction in type 2 diabetes mellitus patients is more relative to systolic dysfunction.

**Keywords:** Cardiac dysfunction, TMT, Cholesterol, Stress test

### INTRODUCTION

Diabetes mellitus is one of the most prevalent disease seen globally. There is a close association between diabetes and cardiovascular diseases. Study done by Dortimer et al reported that diabetics have more diseased coronary vessels and display a greater severity of disease with higher incidence of multiple vessel involvement.<sup>1</sup> The Framingham study showed that diabetes independently increased the relative risk of coronary artery disease (CAD) for men than in women.<sup>2</sup>

CAD in diabetes mellitus is associated with hyperlipoproteinemia, hypertension, obesity and smoking. Hypertension is one of the risk factor for CAD and is more prevalent in diabetics than the non-diabetic population according to Gordon and Alonzo et al proved CAD is twice as common in the hypertensive diabetics than non-hypertensive diabetes subjects.<sup>3,4</sup> Rosengren et al found for the same values of cholesterol, the risk of CAD in non-diabetic control was 2.4 and 4% respectively.<sup>5</sup> Uusitupa et al had reported a prevalence of 40% and 47% of CAD in diabetic men and women

respectively with BMI >28 kg/m<sup>2</sup> as compared to 25% and 26% in diabetic men and women with BMI <28 kg/m<sup>2</sup>.<sup>6</sup>

Smoking is a single most important modifiable risk factor for CAD. Rosengren et al reported that CAD risk in diabetics varied with smoking status with nonsmokers having a prevalence rate of 5.6% as compared to 19.1% in smokers.<sup>5</sup> In non-diabetic controls, the prevalence rate of CAD for nonsmokers and smokers was reported to be 3.1 and 7.5% respectively. Increased diastolic myocardial stiffness in the presence of normal left ventricular systolic function and mass is the earliest discernible evidence of diabetic cardiomyopathy. Even quite early in the course of metabolic derangements of diabetes mellitus, 50 to 60% diabetic patients have been reported to show some degree of diastolic abnormality Schannwell et al.<sup>7</sup> The pathological evidence described the phenomenon of microangiopathy included sub endothelial, endothelial fibrosis and endothelial proliferation with PAS positive material in 50% patients with diabetes compared with 21% of non-diabetics according to Rubler et al.<sup>8</sup>

It has been advocated as a simple noninvasive modality to screen asymptomatic individuals who are considered at high risk for CAD by Froelicher et al.<sup>9</sup> Positive test with ST segment depression 2 mm or more usually indicate definite evidence of coronary artery disease Epstein et al.<sup>10</sup> The exercise test is primarily used to assess the etiology of chest pain and for early detection of coronary artery disease. In addition, the exercise test provides valuable information in evaluating the functional capacity of the patients with coronary artery disease and the efficacy of medical and surgical therapy. Modified light workload exercise protocols are recommended for patients with relatively recent myocardial infarction for assessment of functional capacity and clinical parameters before the patients are discharged or before they return to their previous occupation

With the newer investigational techniques like 2D echocardiography and Doppler which are less expensive and non-invasive, it is now possible to discern functional disturbances of the cardiovascular system quite early. Keeping these in view, it was thought pertinent to study patients of type 2 diabetes mellitus for analysis of cardiac function noninvasively. The objective of the study was to assess cardiac dysfunction by TMT performance in diabetic patients and to study the factors associated with cardiac dysfunction (using values of TMT) in diabetic patients.

## METHODS

The study was done using cross sectional study design. The investigator along with medical team collected data using semi structured questionnaire. The patients approached to OPD of the medical college in Rewa district was selected for the sample with informed consent. Convenient sampling was done for first fifty patients who were willing to be part of the study during the time period from May 2006 to October 2007 at SS medical college and associated SGM hospital. Detailed history of the subjects with special reference to symptoms pertaining to diabetes mellitus and coronary risk factors (smoking, addiction, hypertension, dyslipidemia, family history of coronary artery disease etc.) were recorded. All subjects were subjected to Treadmill stress testing. Patient Instructions were instructed to reach the TMT room approximately 1-1.5 hour prior to the start of test. Not to eat for at least 2 hours before the test. The preceding meal should be light and free of coffee, tea and alcohol. To wear light and loose-fitting cloths and comfortable shoes. Not to smoke or chew tobacco before the test. Not to take drugs like digitalis, nitroglycerine prior to the test. Informed consent for the procedure was taken by the patients. The procedure was explained to the patients in detail Blood pressure was recorded during each step. Now the patient was asked to walk on the treadmill which was programmed. Progressive exercise was continued for 3 min at different levels as described until the end point to terminate the test was reached. ECG was constantly monitored and recorded at every 3 minutes interval. Blood pressure was also recorded at the end of each stage of the exercise. ECG and blood pressure were recorded immediately after termination of exercise and then after 3-and 6-minutes during recovery and longer if abnormality appeared or persisted. Monitoring was continued until the changes resolved while the patient was in supine position. The data was entered into excel and exported to SPSS version 17. Frequency was expressed in proportions. The association of categorical variables was done using Chi-square test.

## RESULTS

Total of 50 patients were enrolled in the study. 32% of the samples were coming between the age group 30 to 45years. In the study group, maximum cases were in the age group of 46-60 years and the incidence of positive stress test was higher in this age group. More than 60 years aged patient comprised of 22% of the sample. 66% of the samples were males and 34% were females.

**Table 1: Depicting association between age wise distribution of diabetics and positive TMT.**

Age group (years)	Number of Patients (%)	Tread mill test		Chi square value	P value	Level of significance
		Positive (%)	Negative (%)			
30-45	16 (32)	Nil	16 (100)	3.18	0.203	Not significant
46-60	23 (46)	04 (17.39)	19 (82.61)			
>60	11 (22)	01 (09.09)	10 (90.91)			

There is no significant association between age wise distribution of diabetes and positive TMT. In this study most of the cases were males (66%) but the positive results for stress test were more in females (11.76%). The findings were statistically insignificant (p=0.76). The above table shows that 31 out of 50 patients were tobacco addicts and out of these 31 patients, 3 patients (9.97%) were positive for TMT as compared to 2 out of 19 patients who were not tobacco addicts (10.53%). 70% of the population belongs to group having less than 5 years of diabetes duration. 20% of the samples falls in between 6 to 10 years of duration of diabetes. 10 % of the population had duration of diabetes more than ten years. This study shows that the maximum number of patients

had a diabetic duration <5 years and maximum number of TMT positivity was found in this group (11.43%). The study shows that the majority of the patients (44%) belonged to the middle class but the positive results for stress test were higher in the upper class (20%) and was (9.09%) in the middle class. Majority of the patients (50%) had an average life style but positive results for stress test were higher with cases who led a sedentary life style (13.64%). The study depicts that the majority of patients (70%) had serum. cholesterol level less than 200 mg/dl but the positive results for stress test were higher in patients with Serum. cholesterol level 200 to 239 mg/dl. But none of the patients with serum. Cholesterol level >240 mg% had positive TMT.

**Table 2: Association between complications of diabetes mellitus and positive TMT.**

Association between nephropathy and positive TMT					
Nephropathy	Tread mill test		Chi square value	P value	Significance
	Positive (%)	Negative (%)			
Present (n=5)	01 (20)	04 (80)	0.61	0.43	Not Significant
Absent (n=45)	04 (8.88)	41 (91.22)			
Total	05	45			
Association between retinopathy and positive TMT					
Retinopathy	Tread mill test		Chi square value	P value	Significance
	Positive (%)	Negative (%)			
Present (n=14)	01 (7.14)	13 (92.86)	0.17	0.675	Not Significant
Absent (n=36)	04 (11.11)	32 (88.89)			
Total n=50	5	45			

The above table shows that 01 out of 05 patients (20%) with overt nephropathy had diastolic dysfunction. The above table shows that 1 out of 14 patients (7.14%) with retinopathy had diastolic dysfunction compared to 11.11% in those without retinopathy.

group. The range of BMI between 25 to 29.9 is 28%. Maximum number of patients had BMI in the range of 19-24 kg/m<sup>2</sup> (68%). The incidence of TMT positivity increased with increase in BMI. The maximum positive results for stress test were with cases who had BMI >30 kg/m<sup>2</sup> (50%) though samples were less.

The majority of the samples (68%) were in normal BMI

**Table 3: Depicting association between systolic blood pressure and positive TMT.**

Association between systolic blood pressure and positive TMT						
Systolic blood pressure (mm Hg)	Number of patients (%)	Tread mill test		Chi square value	P value	Significance
		Positive (%)	Negative (%)			
<120	04 (08)	01 (25)	03 (75)	2.932	0.402	Not Significant
120-139	24 (48)	01 (4.17)	23 (95.83)			
140-159	18 (36)	02 (11.11)	16 (88.89)			
>160	04 (08)	01(25)	03 (75)			
Total	50	05	45			

The study came with result that positive stress test was more in patients with systolic blood pressure <120 mm/Hg and in those with systolic blood pressure >160 mm/Hg. But the results were not significant. Followed by 36% of patients with systolic blood pressure in the range of 149-159.

**DISCUSSION**

In the present study done at district of Rewa, 10% of the patients had TMT positivity. The prevalence of positivity by noninvasive tests varied widely. The Milan and Blandine et al study reported TMT positivity of 12 and

15.7% respectively while Koinstinen and Naka et al reported positivity of 29 and 31% respectively.<sup>11-14</sup> In the present study, the maximum number of TMT positive cases were in the age group of 46-60 years (17.39%) followed by 9.09% in the age group more than 60 years. This observation was statistically insignificant.

A similar trend was observed by Raheja et al who found maximum positivity in the age range of 41 to 60 years which corresponds to the observations in the present study though it is statistically insignificant.<sup>15</sup> Premlata et al showed a positive association of age of the patient with TMT positivity and the maximum positivity was seen in the age group more than 60 years (48.4%).<sup>16</sup> Sargin et al reported a positive correlation of patients age with TMT positivity (age of TMT negative cases was  $54.2 \pm 9.3$  years compared to TMT positive cases where age of the patients was  $59.31 \pm 8.2$  years ( $p < 0.005$ )).<sup>17</sup> In the present study, there was increased positivity of stress test in females compared to males (11.76 vs 9.09%). But statistically this finding was insignificant. Milan et al study reported a higher incidence of TMT positivity in males with type 2 DM.<sup>11</sup> Gupta et al reported a higher incidence of positive TMT in male (18.8%) than in females (10.5%).<sup>18</sup>

Raheja et al showed an equal incidence of coronary artery disease in both the sexes.<sup>15</sup> Sargin et al reported no significant correlation between gender of the patients and TMT positivity.<sup>17</sup> Koistenin and Premlata et al, has reported that IHD is as common in females as in male diabetic patients by treadmill test.<sup>13,16</sup> In the present study, among the TMT positive cases, 03 subjects (13.64%) had a sedentary life style whereas 02 subjects (8%) spend a physically average life style. But statistically this finding was insignificant. Morris et al reported that coronary artery disease was more common in people leading a sedentary life style.<sup>19</sup>

In the present study, 9.97% of the patients was addicted to tobacco had a positive stress test as compared to 10.53% in those without tobacco addiction. Statistically this observation was insignificant. Premalata et al reported a higher TMT positivity in cigarette smokers but failed to reach statistical significance.<sup>16</sup> In contrary to this, Stamler et al has reported that the risk of coronary artery disease in diabetics who were smokers was 15.5% as compared a 10.5% in non-smokers.<sup>20</sup>

In the present study, the trend of increased rate of positivity of stress test with increasing BMI was seen in the diabetic patients. Among the diabetic patients, the maximum positivity to stress test was seen in those with BMI more than 30 kg/m<sup>2</sup> (50%). But statistically this finding was insignificant probably because of the small sample size. Rosengren et al reported a positivity rate of 5% in those with BMI  $\leq 22.9$  kg/m<sup>2</sup> as compared to 14.5% in those with BMI  $> 28$  kg/m<sup>2</sup>.<sup>5</sup> Gupta et al studied 2212 adults of 20 years and above, observed coronary risk factor in 11% of obese adults whose BMI was greater

than or equal to 27 kg/m<sup>2</sup>.<sup>18</sup> Ramachandran et al studied 953 subjects and observed that the prevalence of obesity as a risk factor of CAD was more as compared to hypertension.<sup>21</sup> Sargin et al reported no significant association between TMT positivity and BMI of patients.<sup>17</sup>

In the present study, TMT positivity was 33.33% in those with serum cholesterol levels of 200-239 mg% as compared to 2.86% in those with serum cholesterol levels  $< 200$  mg/dl. Statistically this finding was significant. Similar to the present study, Stamler et al reported that the risk of coronary artery disease varied from 8.6% in diabetics with serum cholesterol  $< 180$  mg% to 16% in those with serum cholesterol  $\geq 280$  mg%.<sup>20</sup> According to Giral et al a positive exercise electrocardiogram is not an infrequent occurrence in asymptomatic hypercholesterolemic patients but the number of false positive results may be relatively high (50%).<sup>22</sup> Sargin et al reported no significant correlation between TMT positivity and lipid profile of the patients (total Cholesterol  $186.63 \pm 50.1$  mg% in TMT negative group compared to  $187.9 \pm 39.7$  mg% in TMT positive group).<sup>17</sup>

In the present study, out of the 50 patients, 16 had diabetic complications of which 3 patients (18.75%) had positive TMT as compared to 5.88% positive TMT in those without diabetic complications. This shows an increased incidence of diastolic dysfunction in those with diabetic complications though this was statistically not significant. Among the patients with overt Nephropathy, 20% had positive TMT compared to 5.88% in those without diabetic complications. In the present study, the incidence of diastolic dysfunction in those with overt nephropathy, retinopathy and peripheral neuropathy were 60, 64.29 and 80% as compared to 41.18% in those without diabetic complications.

Association of cardiac dysfunction with retinopathy was not observed in MILAN study (1997). But Naka and Blandine et al reported a correlation between retinopathy and positive TMT ( $p < 0.05$ ). In a prospective cohort study, Cheung et al studied 1524 middle aged type 2 diabetic patients of which 214 (14.7%) had diabetic retinopathy.<sup>12,14,23</sup> Over an average follow up of 7.8 years, there were 209 (13.7%) incidents of CHD events. The increased risk of CHD was significant in both men (1.89%, 1.08-3.3) and women (2.16, 1.16-4.02) with diabetic retinopathy.

Ruther et al reported a higher incidence of positive TMT among diabetics with nephropathy than those without (75% vs 47%).<sup>8</sup> In the present study, the positivity of stress test was 25% in both groups of patients who had systolic blood pressure  $< 120$  mm and those with systolic blood pressure  $> 160$  mm Hg. Statistically this observation was insignificant probably because of the small sample size. Stamler et al reported a rising incidence of CAD with increasing blood pressure among diabetics.<sup>20</sup> The figures were 6.8% in those with systolic

blood pressure <120 mm Hg and 29.5% in those with systolic blood pressure  $\geq$ 200 mm Hg.

Turner et al reported a hazard ratio of 1.72 for coronary heart disease in type 2 diabetics with arterial hypertension particularly in those with systolic blood pressure >142 mm hg.<sup>6</sup>

Premlata et al reported a positive correlation of systolic blood pressure with TMT positivity in a study conducted in 599 NIDDM patients.<sup>16</sup> In the present study, 4 out of 5 patients (11.43%) with positive TMT had a diabetic duration of less than 5 years compared to 1 out of 5 positive TMT (10%) in those with diabetic duration of 6-10 years. Statistically this finding was insignificant. Similar to the present study, Janand-Delenne et al reported no association between duration of diabetes and positive results.<sup>24</sup> Contrary to this finding, Sargin et al reported association between duration of diabetes and TMT positivity (6.12 $\pm$ 5.4 vs 8.07 $\pm$ 5.9 years in TMT negative group and TMT positive group respectively,  $p<0.05$ ).<sup>17</sup>

## CONCLUSION

It can be concluded that the incidence of left ventricular diastolic dysfunction in type 2 diabetes mellitus patients is higher in comparison to systolic dysfunction in those who are of clinically detectable heart disease. Diastolic dysfunction was highest in patients more than 60 years of age. The incidence of diastolic dysfunction increased as the duration of diabetes increased. The maximum number of the study population had diabetes for duration of less than 5 years. But the incidence of diastolic dysfunction was the highest in patients with diabetes duration more than 10 years. This shows that the incidence of LVDD increases as the diabetic duration increased. The highest incidence of diastolic dysfunction was seen in patients with BMI between 25-29.9 kg/m<sup>2</sup>. It was found most of the study population had addiction to tobacco or alcohol. The incidence of diastolic dysfunction was most in alcoholics compared those with smoking.

The incidence of diastolic dysfunction was higher in patients with diabetic complications compared to those without diabetic complications. Most of the patients with peripheral neuropathy, nephropathy and retinopathy had diastolic dysfunction. Diabetic complications may be independently associated with LVDD. Majority of the patients had high serum cholesterol and the highest incidence of positivity to TMT. The limitation of the study is that the sample size is less and there could be more variables included to study association between them. This study had showered light for early diagnosis of cardiac dysfunction by appropriate tests and stress on appropriate treatment to prevent further worsening of the disease.

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