Original Research Article

A STUDY OF SILENT CARDIAC CHANGES IN TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: India is world's diabetes Capital. The prevalence of Type 2 Diabetes Mellitus is expected to rise more rapidly in the future in India and 40 other countries because of increasing obesity and reducing activity levels and other life style changes. It is well established that coronary artery disease is a major complication of diabetes mellitus, representing the ultimate cause of death in more than half of all patients with this disease. In this study we made an effort to know the cardiac changes present in the patients of Type 2 Diabetes, who do not have any symptoms relating to cardiovascular system and to demonstrate the presence of silent myocardial ischemia in asymptomatic patients of Type-2 Diabetes Mellitus.

Materials and Methods: 60 Type 2 diabetes patients for more than one year duration with age 40-70 yrs who do not have any complaints relating to cardiovascular system were included in this study. All were assessed with detailed history, clinical examination and relevant investigation including resting ECG and Treadmill test. Patients with H/O myocardial infarction, uncontrolled blood pressure and other chronic diseases were excluded from the study.

Results: In the 60 diabetes patients in Present study, 32 patients were males and remaining 28 were Females. None of our patients showed Resting. ECG and 2D ECHO changes. 11 patients from Present study group showed inducible ischemia in the Treadmill test. Hypertriglyceridemia which is a common risk factor associated with coronary artery disease was found in 31 patients (51.66%) in Present study group.

Conclusion: This study shows that type 2 diabetes patients especially of longer duration should undergo cardiac evaluation even though they do not have any symptoms relating to cardiovascular system.

Keywords: 2 Diabetes Mellitus, silent myocardial ischemia, Hypertriglyceridemia, Coronary artery disease, cardiovascular disease.

INTRODUCTION

The term diabetes mellitus refers to a group of metabolic disorders characterized by chronic hyperglycaemia and these disorders usually result from defects in Insulin secretion, insulin action, or both.[1] Type 2 diabetes is by far the most common form of diabetes on a global scale (-95% of all cases) during the past few decades. The worldwide prevalence of DM has risen dramatically to 537 million in 2021.

Type 2 diabetes prevalence varies significantly between high and low-risk populations, with the lowest rates reported in less-developed countries and the highest prevalence in populations like North American Indian and Pacific Islands.

Social and behavioural changes, such as decreased physical activity and overconsumption of energy-dense foods, are key factors in the recent explosion of type 2 diabetes.[3]

Sex ratios vary between populations, with some reports suggesting that type 2 diabetes is more common in men than women.

The thrifty genotype hypothesis suggests that certain populations have a high prevalence of genetic traits that once conferred survival advantages during periods of meagre nutrient supply but may now be detrimental due to abundant food supplies and reduced habitual levels of physical activity.[4]

The Fetal origins hypothesis proposes that type 2 diabetes results from relative intrauterine malnutrition and leads to life-long metabolic programming, including a reduced complement of islet B cells and insulin resistance in skeletal muscle.[5]

Studies have consistently demonstrated a correlation between low birth weight and an increased risk of type 2 diabetes in middle age, particularly if obesity develops in adulthood.

Other genetic factors suggest a genetic component to type 2 diabetes, with a lifetime risk of 40% for having a single parent with type 2 diabetes. The prevalence of type 2 diabetes increases with age, with glucose tolerance decreasing with age.[5]

Clinical and Metabolic Characteristics:,[6]

Since type 2 diabetes is a heterogeneous disorders certain features, present in most cases, are regarded as typical but not all will necessarily be present in every affected individual. Factors such as ethnicity, age and stage in the natural history of the disorder will also influence its clinical manifestations.

Cardinal clinical and metabolic features of Type 2 diabetes.

- Presentation usually in middle-age or later life
- Overweight / obesity common (present in >75%)
- Symptoms often mild, absent or unrecognized
- Relative rather than absolute insulin deficiency
- Insulin resistance commonly present
- Ketosis- resistant
- Progressive hyperglycaemia- even with anti-diabetic therapy
- Insulin treatment frequently required to maintain long-term glycaemia control.
- Other features of the insulin resistance syndrome -e.g. hypertension, dyslipidaemia present.
- High risk of macro vascular complications which are the main cause of premature mortality.

Association with Obesity:,[7]

The type 2 diabetes and other cardio vascular risk factors are particularly closely associated with visceral (Central abdominal, upper body, truncal) obesity, rather than lower body adiposity. The waist hip ratio is a proxy marker for central obesity that is measured easily in clinical practice.

Sustained hyperglycaemia is associated with complication in the macro vasculature, Micro vasculature and nerves, causing protracted morbidity and premature mortality. Macro vascular complications, particularly coronary artery disease and stroke are increase two to four fold and diabetic patients have a higher prevalence of peripheral vascular disease. Micro vascular complications such as retinopathy and nephropathy, and peripheral and autonomic neuropathy are also common[1]

It is well established that Coronary artery disease is a major complication of diabetes mellitus representing the ultimate case of death in more than half of all patients with this disease. Myocardial infarction in diabetic patients is more expensive when compared to non-diabetic patients and the long term Chest pain is certainly the predominant symptom of ischemic heart diseases and the one most commonly used to establish the type and efficacy of the treatment. However several studies suggest that many individuals with severe coronary artery lesions do not have angina pectoris in these patients Episodes of transient myocardial ischemia may be silent, although abnormal asymptomatic ST changes may be recorded during ambulatory electrocardiogram monitoring.

Silent myocardial ischaemia is a common condition in Type 2 diabetes patients, leading to a late diagnosis and increased risk of complications. The prevalence of silent coronary artery disease (CAD) varies depending on the screening test used and the patient population. In low-risk diabetic patients, silent CAD is 6-23%, while in high-risk diabetic patients, it is not different from symptomatic CAD in terms of prognosis and adverse effects. Recent studies show that the overall prevalence of silent coronary artery disease in symptomatic individuals with diabetes is about 20% to 25%. Silent myocardial ischemia has been a focus of interest in recent decades, with studies finding it common in Type 2 diabetes patients with silent myocardial infarction and having a similar prognosis to those without a history of CHD or Q waves. Recent evidence suggests that lipoprotein (a) and Apo lipoprotein (a) polymorphisms could be used as markers for asymptomatic coronary artery disease in diabetes patients. Silent myocardial ischaemia is more common in patients with Type 2 diabetes than in the general population.[8,9]

Criteria for periodic testing for prediabetes or diabetes in asymptomatic individuals. Sourced from the American Diabetes Association,

1. Testing should be considered in overweight or obese (BMI ≥25 kg/m2 or ≥23 kg/m2 in Asian Americans) adults who have one or more of the following risk factors:

First-degree relative with diabetes

High-risk race/ethnicity

History of CVD

Hypertension (≥140/90 mmHg or on therapy for hypertension)

HDL cholesterol level <35 mg/dL and/or a triglyceride level >250 mg/dL

Women with polycystic ovary syndrome

Physical inactivity

Other clinical conditions associated with insulin resistance

2. Patients with prediabetes (A1C ≥5.7%, IGT, or IFG) should be tested yearly.

3. Women who were diagnosed with GDM should have lifelong testing at least every 3 years.
4. For all other patients, testing should begin at age 45 years.
5. If results are normal, testing should be repeated at a minimum of 3-year intervals, with Consideration of more frequent testing depending on initial results and risk status.

Diagnostic criteria,[10]

Diabetes and prediabetes may bescreened based on plasma glucose criteria, either the fasting plasma glucose (FPG) or the 2-h plasma glucose (2-hPG) value during a 75-g oral glucosetolerance test (OGTT), or A1C criteria.

Criteria for the Screening and Diagnosis of Diabetes		
	Prediabetes	Diabetes
A1C	5.7–6.4%	≥6.5%
FPG	100–125 mg/dL (5.6–6.9 mmol/L)	≥126 mg/dL (7.0 mmol/L)
OGTT	140–199 mg/dL (7.8–11.0 mmol/L)	≥200 mg/dL (11.1 mmol/L)
RPG	≥200 mg/dL (11.1 mmol/L)	

Numerous studies have demonstrated that the presence of silent ischemia during exercise testing or AECG monitory predicts adverse clinical outcome. It is well established that patients with diabetes mellitus have a greater morbidity and mortality from cardiovascular disease than non diabetic patient.

Aims & Objectives
1. To know the cardiac changes present in patients of type-2 diabetes who do not have any symptoms relating to cardiovascular system by Resting ECG & Treadmill test.
2. To demonstrate increased presence of silent myocardial ischemia in asymptomatic patients of Type-2 diabetes mellitus

MATERIALS AND METHODS

This study was done at Kurnool Medical College, Kurnool at those patients attended OPD and IPD between August 2023 to August 2024 were included in this study. This study included 60 NIDDM Patients. The initial evaluation included a medical history taking, physical and systemic examinations.

After the above procedures, routine and specific investigations were done. The patients with type 2 diabetes mellitus for more than one year, who do not have any complaints relating to the cardiovascular system, were included. Specific Investigations done were Routine investigations.

- Urine examination.
- Fasting and Post Prandial blood sugar.
- Serum total cholesterol.
- Serum HDL Cholesterol.
- Serum Triglycerides.
- Serum Creatinine.
- Fundus examination.
- ECG.

- Echo Cardiogram and Treadmill stress test.

Inclusion Criteria
- NIDDM of > 1 yr who do not have any complaints relating to the Cardiovascular System.
- Age 40-70 years.

Exclusion Criteria

Patients with any of the following
1. NIDDM <1Yrs
2. Uncontrolled BP
3. History of MI, Angina, Heart failure, Arrhythmias, LBBB
4. CVA with Neurological deficit
5. Valvular heart disease
6. Cardiomyopathy
7. Previous coronary artery bypass surgery
8. Treatment with Digoxin
9. Chronic Kidney disease
10. Insulin treated then duration from diagnosis to insulin therapy <2Yrs.

RESULTS

This table summarizes the demographic and clinical characteristics of patients with Type 2 Diabetes Mellitus. It includes sex distribution, showing a slightly higher percentage of males (53.33%) than females (46.67%). The majority of patients were diagnosed with diabetes between the ages of 41-50 (66.67%). Most patients had diabetes for less than five years (50%), with a smaller proportion having the condition for more than 15 years (6.67%). [Table 1]
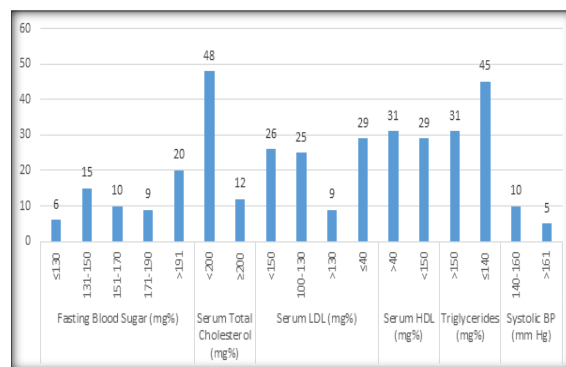
Table 1: Distribution of Patients with Type 2 Diabetes Mellitus Based on FBS, Lipid profile, BP

This graph summarizes fasting blood sugar levels, 33.33% of patients had levels above 191 mg%, while 10% had levels ≤130 mg%. Regarding serum total cholesterol, 80% of patients had values below 200 mg%, and 20% had elevated levels. For serum LDL, 43.33% of patients had levels under 150 mg%, while 15% had levels greater than 130 mg%. Serum HDL was higher than 40 mg% in 51.66% of patients, and triglycerides were above 150 mg% in 51.66% of the population. In terms of systolic blood pressure, 16.67% of patients had a systolic BP of

140-160 mm Hg, and 8.33% had BP above 161 mm Hg.

This table presents the distribution of patients based on BMI, gender, and waist-to-hip ratio. For BMI, 46.67% of patients had a BMI of less than 25, with a mean of 22.35, while 53.33% had a BMI greater than 25, with a mean of 27.37. Gender distribution shows 53.33% of males with a mean age of 48.84, and 46.67% of females with a mean age of 54.33. Waist-to-hip ratios indicate that 85% of males had a ratio above 0.95, while 15% had lower ratios. [Table 2]

Table 1: Demographic and Clinical Characteristics of Patients with Type 2 Diabetes Mellitus

Parameter	Category	No.	%
Sex Distribution	Male	32	53.33
	Female	28	46.67
Age at Onset of Diabetes	31-40	12	20
	41-50	40	66.67
	>51	8	13.33
Duration of Diabetes (Years)	<5	30	50
	10-May	20	33.33
	15-Nov	6	10
	>15	4	6.67

Table 2: Distribution of Patients with Type 2 Diabetes Mellitus Based on BMI, Gender, and Waist-to-Hip Ratio

PARAMETERS	VALUES	NUMBER	PERCENTAGE	MEAN	SD	NUMBER	PERCENTAGE	MEAN	SD
BMI	<25	28	46.67	22.35	1.06	4	36.36	21.52	1.21
	>25	32	53.33	27.37	1.18	7	63.64	26.49	1.56
GENDER	Male	32	53.33	48.84	9.88	7	63.64	54.57	12.92
	Female	28	46.67	54.33	7.36	4	36.36	57.5	7.85
WAIST/HIP	>0.95 (M)	51	85	0.95	0	9	81.82	0.964	0.0.3
	>0.90 (F)				35				5
	<0.95 (M)	9	15	0.88	0	2	18.18	0.87	0.04
	<0.90 (F)				32				2

DISCUSSION

This study "Silent cardiac changes in Type 2 Diabetes Mellitus" was undertaken at Kurnool Medical College, Kurnool at those patients attended OPD and IPD between August 2023 to August 2024 were included in this study. This study included 60 NIDDM patients.

The initial evaluation included a medical history taking, physical and systemic examinations.

Even though Males were more, not much sex difference observed in the incidence of type 2 diabetes in this study (32 Males and 28 Females. This coincides with Majority of studies done outside which points out that there is no sex difference in the incidence of Diabetes.

Majority of the patients in Present study, 40 patients (66.67%) belong to 5th decade. 50% patients In this study (30 out of 60) had diabetes less than 5 years. 20 patients (33.33%) had diabetes of 5-10 year duration and 10 patients (16.67%) had diabetes more than 10 years.

Lipid abnormalities are associated with higher incidence of ischemic heart diseases, particularly more so in diabetes. The most evident lipid abnormalities noted in Present study was hypertriglyceridemia and Low HDL levels. 31 patients (51.66%) showed high triglycerides and 29 out of 60 (48.33%) showed low HDL. only 12 (20%) showed high total cholesterol and 9 patients (15%) showed high LDL above 130 mg%.

None of our patients showed any cardiac abnormality at rest. (In Resting ECG and 2D ECHO) Treadmill test was undertaken in all the 60 patients out of whom 11 patients showed inducible ischemia without angina. This study coincides with majority of studies done previously.

This study coincides with the study done by sardesai et al.[11]

Where Treadmill testing revealed that 15 patients (25.9%) had positive findings, indicating a prevalence of silent myocardial ischemia of 25.9% of diabetes patients. Positive TMT findings were significantly associated with advancing age of the patients, male gender, and longer duration of DM, in all comparison. Among the clinical and laboratory findings, the only significant correlation was reported between positive findings of TMT and higher level of triglycerides. Coronary Artery Disease detection in asymptomatic type 2 DM is often delayed. The preponderance of SMI in type 2 DM is variable and ranges from 9 to75%. Hirofumi Soejima et al, D.S. Prasad, et al; Mc Donald et al).[12,13,14,15]

A previous study was conducted by Lavekar and Salkar found that 21.1% of diabetic patients had SMI and they were asymptomatic but diagnosed on 24 hours ambulatory monitoring exercise electrocardiogram.[16]

Another Indian study was conducted by Sarginetal. In 2005 Reported that 38.3% of DM with no symptomatic prior CAD had SMI on treadmill test (Sargin et al., 2005),[17]

The higher prevalence of asymptomatic myocardial ischemia or with atypical symptoms in elderly is explained by increased pain threshold related to nociceptive changes and by the great prevalence of diseases such as depression and diabetes mellitus. Increased beta-endorphins levels have also been described in patients with asymptomatic myocardial ischemia (Ahmed et al),[18]

Ahuwalia study found that triglyceride levels were elevated in 28 treadmill positive cases compared to 15 treadmill negative cases. (Ahluwalia et al., 1995),[19]

This study also coincides with the study in New-onset middle aged type 2 diabetic patients to see the prevalence of silent myocardial ischemia by 'AU Fornengo P', Bosio A.[20,21] In that study, 19 patients showed (17.1%) showed inducible ischemia in treadmill test.

In a study by Amit Daphale et al, 2017 it was observed that, 11% cases with type 2 DM tested positive for asymptomatic CAD on exercise stress test whereas only 3% of the non diabetic control group tested positive for asymptomatic CAD on exercise stress test.[22]

The Milan Study on Atherosclerosis and Diabetes (2) attempted to determine the prevalence of unrecognized SMI in patients with diabetes but without known coronary artery disease. Nine hundred and twenty-five patients with type 2 diabetes underwent exercise stress test (EST) followed by exercise thallium scintigraphy if the EST was abnormal. Of these, 12.1% had abnormal stress test alone and 6.4% of patients had an abnormal response to both tests, indicating a high likelihood of previous undetected myocardial ischemia, a figure roughly three times that found in the general population. A higher figure was quoted in Detection of SMI in Asymptomatic Diabetic Subjects (DIAD) study in 2004,[23] which found a prevalence of silent ischemia of 22% in patients with type 2 diabetes and no known coronary artery disease

Among these 11 patients in Present study (18.33%) those showed inducible ischemia in Exercise test, 8 patients (72.73%) were above 50 years of age and remaining 3 (27.27%) were below 50 years which tells us that ischemia develops as age advances even without prominent symptoms. All these 11 patients who had inducible ischemia in exercise test showed ST depression of more than 1mm without angina

In our study, autonomic neuropathy was detected in 4 out of 11.

Asymptomatic diabetics those showed inducible ischemia on TMT. In diabetic patients, autonomic neuropathy was blamed for absent anginal pain during ischemic episodes. In a recent study to correlate the incidence of autonomic neuropathy and silent myocardial ischemia in type 2 diabetic patients by "AU Alhayali J.MT" and "Alnuemi A.A", silent myocardial ischemia was detected in 12 (26.6%) diabetic patients in general. 8 (66.7%) of them had autonomic neuropathy.[24]

It tells us the need of screening of diabetic patients with autonomic neuropathy which is also evident in Present study.

Paradoxically only 4% of our patients showed family H/O of diabetes. All the patients who had family H/o of diabetes (2 patients) also showed silent myocardial ischemia. Thus the importance of family H/O in asymptomatic diabetics cannot be ruled out Present study shows BMI (body mass index) of less than 25 in 28 patients (46.67%) and more than 25 in 32 patients (53.33%). Thus Present study coincides with majority of studies which say higher incidence of weight in diabetics. In Present study waist/hip ratio is more than normal levels (>0.95(M) and >0.90(F) in 51 patients (85%) out of 60 patients. In 11 patients who had inducible ischemia, 9 (81.82%) had W/H ratio above normal levels. So W/H ratio in above normal levels is a proxy marker for cardiac risk. This finding coincides with majority of the studies worldwide.

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CONCLUSION

Even though Males were more, not much sex difference observed in the incidence of type 2 diabetes mellitus. Most number of the patients belong to 5th decade. Commonest lipid abnormality observed in patients is hypertriglyceridemia. None of patients had resting ECG changes and 2D ECHO cardiac abnormalities. 18.33% (11 out of 60) of Asymptomatic diabetics showed inducible ischemia on TMT without symptoms of angina. The present study had low incidence of family history of diabetes (4%). All the patients who had family history showed inducible ischemia. Truncal obesity which is measured as waist/hip ratio is better indicator of Silent ischemia in diabetes than BMI. Autonomic neuropathy was detected in 4 out of 11 asymptotic diabetics those showed inducible ischemia on TMT. Thus the present study shows patients with type 2 diabetes of longer duration particularly after 4th decade should undergo

evaluation for inducible ischemia even though they are asymptomatic.

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