A CROSS-SECTIONAL STUDY OF SILENT MYOCARDIAL INFARCTION AMONG TYPE 2 DIABETICS.

Prashant Kumar[a*] , Akhilesh Kumar[b], Rahul Raj[b]

[a]Assistant Professor, Department of Medicine, Darbhanga Medical College and Hospital, Laheriasarai, Bihar, India.

[b]Junior Resident (Academics), Department of Medicine, Darbhanga Medical College and Hospital, Laheriasarai, Bihar, India.

Abstract

Introduction:
Diabetes mellitus type 2 typically affects adults when the body doesn't produce enough insulin or grows resistant to it, leading to several micro- and macrovascular. This study used an activity treadmill test to assess the severity of silent myocardial ischemia, a significant macrovascular consequence, in a subset of asymptomatic diabetic outpatients.

Material and Methods:
The cross-sectional observational research was conducted from September 2022 to September 2023 at the Darbhanga Medical College and Hospital in Laheriasarai, Bihar, India. The study comprised 250 asymptomatic type 2 diabetes mellitus (DM) patients without clinical symptoms of coronary artery disease (CAD) and normal electrocardiograms. Patients with heart failure, angina pectoris, previous myocardial ischemia (MI), or any other chronic ailment were not eligible to participate in the trial. A silent myocardial infarction was identified by CASE/T2100 sr number GE MAC using a treadmill test (TMT) conducted following the Bruce protocol.

Results:
Silent MI was present in 12.8% of diabetic individuals with positive TMT. Diabetes for more than 10 years (p=0.001), Age (p=0.002), dyslipidemia (p=0.001), and having an HbA1c were all substantially associated with TMT favorable of more than 10% (p=0.001). It was found that TMT-positive individuals had significantly higher levels of triglycerides, LDL cholesterol, and total cholesterol than TMT-negative patients. Compared to TMT-negative patients, those who tested positive for TMT had significantly lower HDL levels.

Conclusion:
Many people experienced asymptomatic coronary artery disease or silent myocardial infarctions when they had type 2 diabetes. Silent MI was more common in diabetics who were overweight, dyslipidemic, older, and had increased HbA1C levels. When it first started, TMT might be an easy, non-invasive way to identify this.

Recommendation:
We recommend that being physically active helps you manage your diabetes because it increases your body's sensitivity to insulin, the hormone that permits your body's cells to use blood sugar for energy. In addition to lowering blood sugar levels and heart disease risk, physical activity helps regulate both

Corresponding author: Prashant Kumar*
Email: dr.prashantkr@gmail.com
Department of Medicine, Darbhanga Medical College and Hospital, Laheriasarai, Bihar, India.

Introduction

One metabolic disorder linked to diabetes mellitus (DM) is hyperglycemia. The most common is type 2 diabetes, which often affects adults and is caused by the body becoming resistant to insulin or producing insufficient insulin, which lowers blood glucose levels and enhances glucose utilization. India is home to 69.2 million people. In 2015, 8.7% of people worldwide had diabetes, according to W.H.O. [1]. Diabetes is a global epidemic. Unfortunately, most people in developing countries are more prone to getting the disease rapidly [2].

Diabetes can cause both short-term and long-term problems. Acute complications include hypoglycemia, hyperosmolar hyperglycemic nonketotic coma, and diabetes ketoacidosis. The two types of chronic issues are microvascular and macrovascular [2]. Diabetes is the only cause of microvascular complications such as retinopathy and neuropathy. Peripheral artery disease (PAD), coronary heart disease (CHD), and cerebrovascular illness are macrovascular issues. These disorders are similar to those

that more commonly affect diabetics but also affect non-diabetics [3].

Asymptomatic coronary disease and Type 2 diabetes are well-documented conditions. Conventional risks in persons with type 2 diabetes who have cardiovascular disease (CVD) include smoking, poor glycemic control, obesity, dyslipidemia, and hypertension [3, 4]. Lipid abnormalities are more common in T2D patients [4]. Insulin resistance is linked to atherogenic dyslipidemia, also known as diabetic dyslipidemia. Vitamin shortages, hyperhomocysteinemia, erectile dysfunction, glucose variability, microalbuminuria, hematologic factors, thrombogenic factors, postprandial hyperglycemia, inflammation indicated by elevated C-reactive protein, genetics, and epigenetics are additional non-traditional risk factors for CVD in T2D patients [5].

It has been demonstrated that individuals with diabetes tend to have silent ischemia more frequently than non-diabetic individuals [6-8]. In type 2 diabetes, the cardiac flow reserve will be diminished. Hyperglycemia primarily impairs vascular function by increasing oxygen species (reactive) generation produced by available endothelium. It is believed that afferent sympathetic fibers are essential to the feeling of angina. When there is autonomic dysfunction, they could change [8].

Those who are diagnosed with diabetes mellitus, in addition to any one of these risk factors, must also meet one or more of the following requirements. (1) abnormal or recurrent cardiovascular symptoms; (2) laying ECG suggesting a myocardial infarct or ischemia; (3) peripheral or carotid occlusive blood vessel disease; (4) sedentary lifestyle; (5) age 35 to begin a vigorous exercise routine; and (5) a combination of the following risk factors: smoking, blood pressure of 140 over 90 mm Hg, micro- or macroalbuminuria, delayed CAD in family history, total cholesterol level of 240 mg/dL, LDL of 160 mg/dL, and HDL of 35 mg/dL [9, 10].

Routine quarterly clinical examinations and resting ECGs frequently miss coronary artery disease. Exercise electrocardiograms (ECGs) remain the gold standard for identifying individuals at risk of severe ischemia during daily activities, as they identify most patients. There was research to clarify the risk indicators that may aid in forecasting the subset of diabetics susceptible to developing asymptomatic CAD [11]; nonetheless, unreliable outcomes have not been discovered [12]. One such diagnostic treatment includes treadmill tests, whose prognostic and diagnostic significance was widely explored [13]. Along with food and medicine, exercise is essential to managing diabetes [14]. Patients with diabetes are typically encouraged to exercise indoors and outdoors and to use fitness equipment like treadmills, similar to walking.

Notably, there are recommendations without evidence for filtering asymptomatic diabetics for (CAD). The activity treadmill test is one well-researched screening method. Abnormal stress tests are standard even in diabetics without CAD symptoms. Medical practitioners may be better able to safeguard the use of treadmill testing on asymptomatic patients if they can identify cardiovascular risk factors and classify their patients accordingly.

Aim of the Study

This study aims to examine the degree of silent myocardial ischemia in a subgroup of asymptomatic DM outpatients and to investigate the effectiveness of the exercise treadmill test in type II diabetes patients.

Materials & Methods

Study Setting

From September 2022 to September 2023, a cross-sectional observational study was conducted at the Darbhanga Medical College and Hospital in Laheriasarai, Bihar, India.

Study Population

People with asymptomatic type 2 Diabetes Mellitus, aged 40–60, made up the study cohort. exhibiting both genders and lacking clinical symptoms of coronary artery disease, average resting ECG attendance, and out-of-pocket medication for diabetes.

Study size

A 95% confidence interval, a 10% tolerance for error, and an anticipated 37% TMT positive rate among diabetics without symptoms were used to calculate the sample size. The sample size was determined using the following formula for the estimate of a single sample proportion:

$$N = Z1-\alpha/2 \; 2 \; P \; (1 - P) \; E2$$

Inclusion Criteria:

We include 250 patients suffering from Diabetes mellitus in this study.

Exclusion Criteria:

Individuals with an underlying medical condition such as heart failure, angina pectoris, anemia, hypertension, renal illness, ischemic ST-segment or T-wave abnormalities on the ECG, completed LBBB, or chronic disease resulting from liver disease, ESRD, or cancer was not allowed to participate in the trial.

Data Collection:

A thorough history, a specific clinical examination, a resting electrocardiogram, and all required tests (Renal function test, Hba1c Complete blood count, FBS, Lipid profile, Complete urine examination) were conducted on each patient to establish eligibility. A similar standard process was followed for all blood testing and sampling at the center's central laboratory. Patients were instructed to report to the hospital's clinics the following day following a 4- to 5-hour fast without consuming any calories for the treadmill test.

Alcoholics and smokers were told not to consume any of these substances on the morning of exploration. It was stated that the situations had typical BMI as it varied from 18.5 to 22.9 kg/m^2 in the range Overweight if BMI was in the 23–

24.9 range lbs/m^2 and fat has a BMI ranging from 25 to 29.9 kg/m^2. Abdominal obesity is defined as a man's waist of more than 90 cm and a woman's circumference of more than 80 cm in the updated NCEP ATP III guidelines of Asian descent. Every research participant had a 15-meter sprint test with identical settings and a consistent technique.

Statistical Analysis

The Chi-square test assessed categorical data reported as percent and frequency. The independent sample t-test was utilized with the continuous variables' mean and standard deviation for analysis. P-values may be significant if they are less than 0.05. The EPI INFOTM version 7.2.1.0, CDC, Atlanta, GA, USA, 2017 statistics tool was there for all analysis.

Ethical Consideration:

The study complies with the bioethics guidelines set forth by the Indian Council of Medical Research. The study proposal has been approved by the institutional ethical committee of Darbhanga Medical College and Hospital in Bihar, India. Prior to the trial, each participant provided written, informed consent.

Results

The required age of the diabetic patients was 48.89 ± 6.1 years and the ratio of 1.72:1 in males to females. It was discovered that 12.8% of diabetics had silent MI (positive TMT). Patients between the ages of 50 and 60 years showed considerably (p=0.002) higher rates of silent MI (TMT positive) than those between the ages of 40 and 50 years (5.8%). Patients with diabetes for more than ten years (55.6%) showed higher TMT positivity than those with diabetes for five to nine years (6.7%) and DM for less than five years (4.3%).

Patients with dyslipidemia had a considerably greater TMT-positive rate (50%) than those without the condition (4%). Subjects with a HbA1c >10% (60%) had a greater TMT positive rate than those with a HbA1c 7–10% (10.1%) and <7%. Patients with high BMI, high waist circumference, smoking, drinking, and sedentary lifestyles had higher rates of silent MI. (Table 1)

Table 1- Factors linked to silent MI in individuals with diabetes

Variables		TMT Negative		TMT positive		Total	P value
		N	%	N	%	N	
Age group	40 -50 years	130	94.2	8	5.8	138	0.002 (S)
	50-60 years	88	78.6	24	21.4	112	
Gender	Female	94	85.5	16	14.5	110	0.084
	Male	124	88.6	16	11.4	140	
Socio-economic status	Lower	46	92	4	8	50	0.414
	Middle	160	85.1	28	14.9	188	
	Upper	12	100	0	0	12	
Residence	Rural	130	89.0	16	11.0	146	0.647
	Urban	88	84.6	16	15.4	104	
Duration of diabetes (years)	<5 years	90	95.7	4	4.3	94	<0.001 (S)
	5-9 years	112	93.3	8	6.7	120	
	10-15 years	16	44.4	20	55.6	36	
BMI (Kg/m^2)	18.5 – 22.9 Kg/m^2	54	93.1	4	6.9	58	0.555
	23 – 24.9 Kg/m^2	70	85.4	12	14.6	82	
	≥25 Kg/m^2	94	85.5	16	14.5	110	
Waist circumference	Normal WC	86	92	4	8	50	0.639
	Raised WC	172	86	28	14	200	
Smoking history	Smoker	20	76.9	6	23.1	26	0.152
	Non-smoker	178	89.9	20	10.1	198	
Alcoholic habit	Alcoholic	38	76	12	24	50	0.124
	Non-alcoholic	180	90	20	10	200	
Physical activity	Active	162	89	20	11	182	0.490
	Inactive	56	82.4	12	17.6	68	
Dyslipidemia	Present	24	50	24	50	48	<0.001 (S)
	Absent	194	96	8	4	202	
HBA1C	< 7%	68	94.4	4	5.6	72	<0.001 (S)
	7 – 10%	142	89.9	16	10.1	158	
	> 10%	8	40	12	60	20	

When comparing TMT-positive individuals to TMT-negative patients, it was discovered that the former had considerably higher levels of total cholesterol, LDL, and triglycerides. TMT-positive individuals had considerably lower HDL levels than TMT-negative patients. TMT-positive subjects had a substantially higher mean HbA1c (10.19%) than TMT-negative subjects (7.74%).

Discussion

The current study aimed to investigate TMT positive in diabetic patients without signs of CAD with a normal ECG report. 125 people of average resting ECG readings who had diabetes mellitus were included in the study, which used a treadmill test. Many diabetic participants in this study, with an average age of 48.89 ± 6.1 years, were between 45 and 49. Most patients were between the ages of 35 and 44, according to Deb et al. [16]. The average age was determined to be 46.20 ± 12.20 years by Daphale et al. [17]. According to previous research by Ditchburn et al. [18], Deb et al. [16], and Joshi et al. [19], men made up the majority of study participants.

In line with the findings of Swaminathan and Gayathri, most diabetic patients have had chronic diabetes for five to nine years. After testing positive for TMT, 12.8% of diabetic individuals without symptoms who underwent treadmill tests developed silent MI [20].

TMT-positive patients had a higher mean HbA1c (10.19%) than TMT-negative patients (7.74%). It was determined that the mean HbA1c difference was statistically significant. TMT positivity was shown to be statistically significant about HbA1c, with participants with HbA1c >10% (60%) showing higher TMT positivity than subjects with HbA1c 7 – 10% (10.1%) and HbA1c <7% (5.6%). Studies of Swaminathan and Gayathri [20], and Lavekar [21] noted similar results.

In the current study, TMT positive was found in individuals who had been diagnosed with diabetes for more than ten years (55.6%), compared to those who had the disease for five to nine years (6.7%) and DM less than five years (4.3%). The statistical significance of this outcome was established. Both Agarwal et al. [12] and Deb et al. [16] reported similar findings. Most patients with TMT positivity have been diagnosed with diabetes for more than 10 years, according to the findings of numerous studies conducted by Joshi et al. [19] and Swaminathan and Gayathri [20].

Conclusion

Most people have asymptomatic CAD or a silent myocardial infarction with type 2 diabetes mellitus. Silent MI was more common in diabetics who were older, had high BMIs, were obese in the abdomen, had dyslipidemia, had uncontrolled blood sugar, smoked, or were drinkers. An easy-to-use, non-invasive, and reasonably priced method is the exercise stress test or TMT to detect silent MI or asymptomatic CAD early on. Early screening of these patients is made possible by identifying the related factors to prevent any imminent cardiovascular events.

Limitation: One of the study's limitations is the tiny sample size that was used. It is not possible to generalize this study's conclusions to a larger sample size. Moreover, the results of this study are limited by the absence of a comparison group.

Recommendation:

We recommend that being physically active helps you manage your diabetes because it increases your body's sensitivity to insulin, the hormone that permits your body's cells to use blood sugar for energy. In addition to lowering blood sugar levels and heart disease risk, physical activity helps regulate both.

List of Abbreviations

CAD - Coronary Artery Disease
MI - Myocardial Ischemia
TMT- Treadmill Test
DM - Diabetes Mellitus
WHO - World Health Organisation
CHD - Coronary Heart Disease
CVD - Cardiovascular Disease
ECG - Electrocardiograms

Source of Funding:

Conflict of Interest:

There was no conflict of interest.

Acknowledgment

References

1. World Health Organisation [Internet]. 2019. Available from: https://www.who.int/health-topics/diabetes
2. Bentley DJ, Newell J, Bishop D. Incremental exercise test design and analysis. Sports medicine. 2007 Jul 1;37(7):575-86.
3. American Diabetes Association. Cardiovascular disease and risk management: standards of medical care in diabetes—2018. Diabetes Care. 2018;41(suppl 1):S86-S104. doi: 10.2337/dc18-S009.
4. Cardiovascular disease and diabetes. American Heart Association website. heart.org/HEARTORG/Conditions/More/Diabetes/WhyDiabetesMatters/CardiovascularDiseaseDiabetes_UCM_313865_Article.jsp#.Wzp_V9JKiUl Updated January 29, 2018. Accessed August 26, 2023.
5. Martín-Timón I, Sevillano-Collantes C, Segura-Galindo A, del Cañizo-Gómez FJ. Type 2 diabetes and cardiovascular disease: have all risk factors the

same strength? World J Diabetes. 2014;5(4):444-470.

6. Wackers FJ, Young LH, Inzucchi SE, Chyun DA, Davey JA, Barrett EJ, Taillefer R, Wittlin SD, Heller GV, Filipchuk N, Engle S, Ratner RE, Iskandrian AE. Detection of silent myocardial ischemia in asymptomatic diabetic subjects: the DIAD study. Diabetes Care. 2004; 27:1954 –1961.

7. Rajagopalan N, Miller TD, Hodge DO, Frye RL, Gibbons RJ. Identifying high-risk asymptomatic diabetic patients who are candidates for screening stress single-photon emission computed tomography imaging. J Am Coll Cardiol. 2005; 45:43– 49.

8. Di Carli MF, Hachamovitch R. Should we screen for occult coronary artery disease among asymptomatic patients with diabetes? J Am Coll Cardiol. 2005; 45:50 –53.

9. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2005;28: s4 –s36.

10. American Diabetes Association. Consensus Development Conference on Diagnosing Coronary Heart Disease in People with Diabetes. Diabetes Care. 1998; 21:1551– 1559.

11. Marwick, TH, Sada, M Detrano R. Screening of CAD, Cardiac Stress testing and imaging: Seventh edition, Churchill Living Stone, 2005: pp126.

12. AK Agarwal, Sweta Singla, S Singla, R Singla, A Lal, H Wardhan, Rajbala Yadav Prevalence of Coronary Risk Factors in Type 2 Diabetics without Manifestations of Overt Coronary Heart Disease. J Assoc Physicians Ind 2009; 47.

13. George D. Harris, MD, MS, and Russell D. White, MD Exercise Stress Testing in Patients with Type 2 Diabetes: When are asymptomatic Patients Screened? Clinical Diabetes 2007; 25:126.

14. Brubaker PH, Kitzman DW. Chronotropic incompetence: causes, consequences, and management. Circulation. 2011 Mar 8;123(9):1010-20.

15. Moy and Bulgiba: The modified NCEP ATP III criteria may be better than the IDF criteria in diagnosing Metabolic Syndrome among Malays in Kuala Lumpur. BMC Public Health 2010 10:678.

16. Dipankar Deb, Jipen Narzary, Giridhari Kar. A study of electrocardiography and treadmill test in type 2 diabetic patients without cardiac symptoms. J. Evolution Med. Dent. Sci;5(69):5010-4.

17. Amit Daphale, Sourya Acharya, Samarth Shukla. Detection of asymptomatic coronary artery disease (CAD) in newly detected type 2 diabetes mellitus (DM) by exercise treadmill test. International Journal of Contemporary Medical Research 2017;4(11):2269-2275.

18. C J Ditchburn, J A Hall, M de Belder, A Davies, W Kelly, R Bilous. Silent myocardial ischemia in patients with proved coronary artery disease: a comparison of diabetic and non-diabetic patients. Postgrad Med J 2001; 77:395–398.

19. Anil Shrinivasrao Joshi, Chandrakant Gunaji Lahane, Akshay Arvind Kashid. The result of a treadmill test in asymptomatic type 2 diabetes mellitus. Int J Sci Rep. 2017 Jun;3(6):166-172.

20. Dr. K. Swaminathan, Dr. M. Gayathri. Study of Treadmill Test Detecting Asymptomatic Coronary Artery Disease in Type 2 Diabetes Mellitus. IOSR Journal of Dental and Medical Sciences;15(8): 01-06

21. Lavekar AS, Salkar HR. Treadmill Test to Detect Stress Induced Ischemic Heart Disease in Type 2 Diabetes Mellitus PatientsAsymptomatic for CAD: A Hospital Based Cross-sectional Study in Rural Population of Central India. J Diabetes Metab 4: 244.

Publisher details: